RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

BRIDGES - BUILDINGS - CONTRACTING - SIGNALING - TRACK

New Series, Vol. VIII
Old Series, Vol. XXVII | Chicago | AUGUST, 1912 | New York | No. 8

SPECIAL ARTICLES IN THIS ISSUE

Centralia Freight Yards, I. C. R. R. 360
Concrete Practice, Grand Trunk Ry. 387
St. Clair Coal Yards, P. & R. Ry. 372

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"Perfection Journal Box Packing"

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ELYRIA, OHIO

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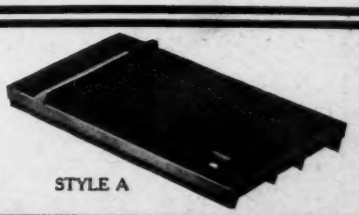

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Are the result of many years experience

"Proved Best by Every Test."

Our track chisels are made from the best crucible tool steel that can be produced for this purpose. Every track tool we make is sold under an absolute guarantee. Our track shovels are standard on many roads. Our locomotive scoops are known to every fireman.

HUBBARD & CO.

Write for Catalog — PITTSBURCH, PA.

Alphabetical Index to Advertisers, Page 18. Classified Index to Advertisements, Page 16.

This Journal has a larger circulation than any other, in the Maintenance of Way Departments of the Railways of the United States and Canada.

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Manufacturers of

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Instruments Carefully Repaired and Adjusted

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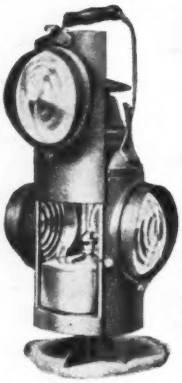

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SWITCH, ENGINE,
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For Electric Railways

During a **four months' service** of a pair of Nachod Automatic Signals on a block of single track of an Ohio Railway, there have been **no failures in 25,000 signal movements;** nor have the signals had any attention or maintenance whatever.

With such results is it wise to take chances?

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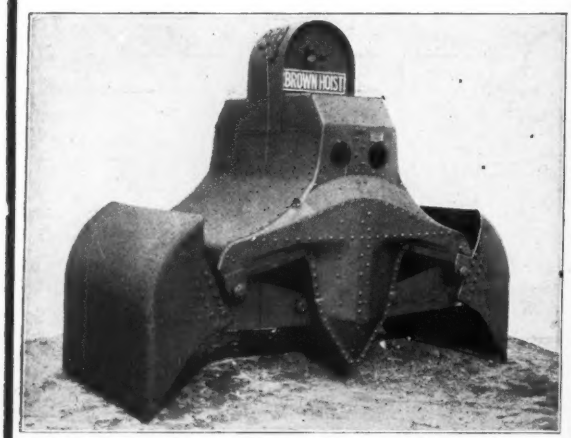

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Wyoming Shovels

Save Their Cost Many Times

You know what it is to have a lot of shovels, that ought to be in the hands of your laborers, out being sharpened. You know what it is to put a gang of men on a job and wonder why they don't remove as many cubic yards of dirt as you think they should. It is because the shovels they are using don't hold their sharp edge.

It is no exaggeration to say that if you put

Wyoming Shovels

into the hands of the laborers you employ, they will remove more dirt in a given time than they have ever done before. That instead of being out of commission half of the time WYOMING SHOVELS will be "on the job," ready for business.

WYOMING SHOVELS really save their cost because with less men you can get more work.

We have an interesting booklet on shovel construction which you ought to read. Let us send it to you.

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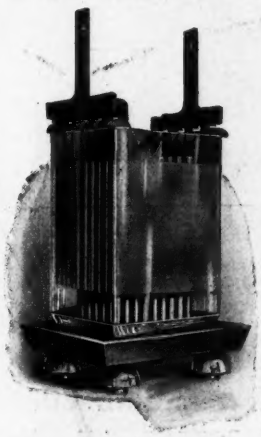
Storage Batteries For Signal Service

U-S-L batteries discharge only when the signal circuit is closed. Although the service be extremely intermittent they retain their capacity—no energy being dissipated uselessly by internal discharge. This desirable feature is secured by our advanced methods of manufacture and the absolute purity of our raw materials.



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A Signal Success

Schoenmehl's R.S.A. Cell

is a result of the combination of

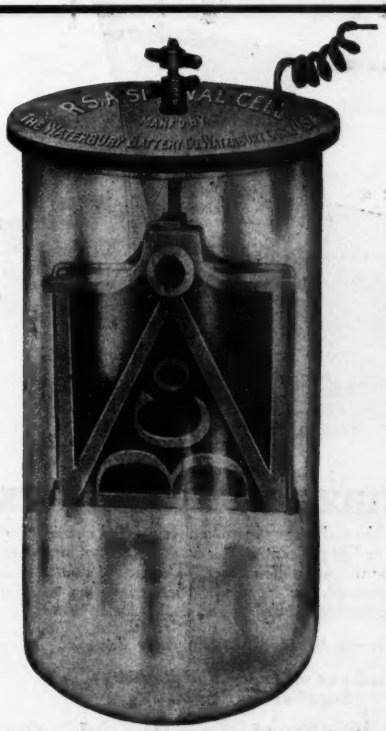
1. **The best materials that can be secured.**
2. **The knowledge, acquired by many years of experience, of how to make a battery.**
3. **The inspiration of a long record of success in filling signaling requirements.**

The logical conclusion, therefore, is that what you get out of the Schoenmehl cell will be entirely in keeping.

And so it is. This conclusion is supported by service records. Why not prove it to your own satisfaction? Install some Schoenmehl batteries and let them show what they can do.

There is a clean saving from the very start; you will reduce maintenance costs to the minimum; and you will have the knowledge when using this type of cell that you have taken the very best step possible to secure efficiency in the operation of your signals.

Every cell is guaranteed for full 400 ampere hours. We have put them in. You can get them out.



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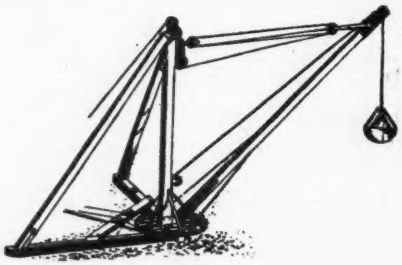
Hoisting Machinery



We can furnish machinery which will absolutely fulfill your requirements, at minimum cost. :: :: ::

WRITE FOR PARTICULARS

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Make Your *Hand Car* ---into a *Motor Car*

You can easily install a **Belle Isle Motor** on your hand car in a couple of hours. The engine will propel any load your car will carry. Save your laborer's strength for real maintenance work, instead of making him pump a back-breaking, slow-running hand car. With a gasoline car you will ***get there*** quicker—easier. You will have ***more time,*** your laborers will have ***more strength*** and ***more inclination*** to do a full day's work.

4 to 5 H. P. = 20 Man Power

Weight, engine only, 125 lbs.
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Fits any section Hand Car.
Smaller size for Velocipedes. Write for Catalog No. 40

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It hauls the material train with its own power.
It automatically distributes material in position on the roadbed.
It does all the lifting and carrying of rails and ties.
It requires 25 to 50 per cent less labor than any other method.
It always full-ties the track—no matter how fast it is laid.

Our booklet illustrates and explains these facts—send for it.

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are equipped with the Kalamazoo Improved Reinforced Pressed Steel Wheel, giving 50 to 100 per cent greater wear than any other wheel of similar design or weight on the market. The car has stout gallows frame, thoroughly trussed, has taper wheel and pinion fits on axles, machine cut gears, flexible steady box and double acting brake.

16 Different Styles, Standard or Special

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Kalamazoo, Mich.

Western Representative: **Universal Railway Supply Co., Chicago**

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A postal telling us what you paint will bring this information gratis.

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MANUFACTURERS AND PATENTEES
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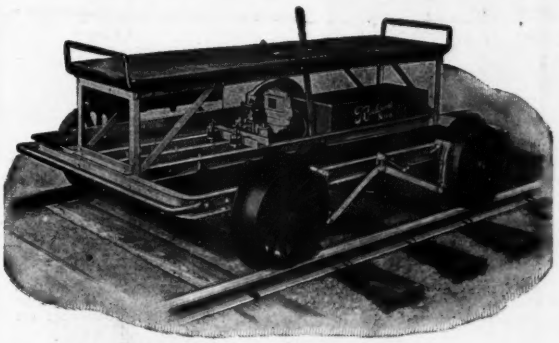
Also Manufacturers of the "Peer" Exhaust Fans and Blowers

WE HAD IT ALL FIGURED OUT

We Knew That if we took the well-known *"Rockford"* Engine, and mounted it in a welded steel channel frame and eliminated dry cells, spark coil and timer, substituting therefor Magneto Ignition, and eliminated chain drive to cam shaft, substituting therefor direct drive through spiral gears, enclosed and running in oil



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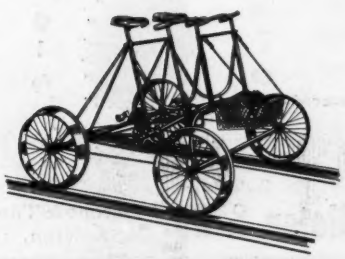

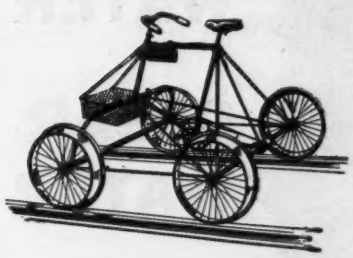

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LIGHT INSPECTION CAR CO.
HAGERSTOWN, INDIANA

Economy is the Best Policy

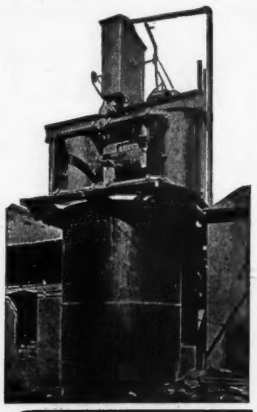
An installation of Water Softeners by one of our railway customers not only enabled it to increase its average freight train haul by 40% more cars but to make a saving of 15% in its fuel cost per train load mile over the previous year.

Over one-third more cars moved and 1600 tons less coal consumed in doing it should appeal forcibly to every railroad man whose locomotives traverse bad water districts.

Write us for a copy of the railroad report upon which the above statement is based.

American Water Softener Co.
1015 Chestnut Street, Philadelphia

"A laborer can operate the American"



PURE WATER AT LESS COST

So uncertain have been the results from many railroad water purifying systems, and so great the first cost of other devices of this kind, that many railways have found this a very serious and troublesome problem.
After fifty years' experience in the water purifying business, and with a thorough knowledge of actual railroad conditions

Lord's Water Softening Apparatus

specially designed, is now solving this problem.
It is far more reasonable in first cost, because of a remarkably simple construction and automatic operation. Its success in the railroad field is conclusively proven by the many installations we now have in actual operation (location on request).
Find out whether this apparatus isn't just what you are looking for. Write your conditions, and at no obligation we'll tell you just what we would recommend, what it will cost, and what you will save.
Or drop us a postal, and get our valuable treatise "Water Softening" which thoroughly discusses the water purifying problem in the railroad field.

Be sure to do one of these two things right away. It will pay you.

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2237 N. Ninth Street - - PHILADELPHIA
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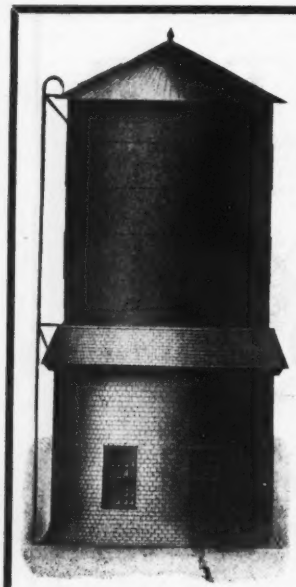
AGENCIES IN ALL PRINCIPAL CITIES



SOFT WATER
CLEAR WATER
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CONTINUOUS SOFTENER

SOFTENERS
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The Most Economical Paint in the Market.

You Specify Your Requirements

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Pendleton & Co. - Front & Thompson Sts. Stapleton, (S. I.) N. Y.

The Johnson Car Replacer

Range and Capacities of the different types are as follows:

	If Not Over	Capacity.	Throat Opening	Wt. Each
Type M for rail 12 - 45 lbs.	3½ Inches high	20 Ton Locomotive	2 Ins.	39
Type C for rail up to 65 lbs.	4½ Inches high	30 Ton Locomotive	2½ Ins.	69
Type B for rail up to 80 lbs.	5 Inches high	50 Ton Locomotive	3½ Ins.	110
Type A for rail up to 100 lbs.	5½ Inches high	80 Ton Locomotive	3½ Ins.	145
Type Z for rail up to 100 lbs.	6 Inches high	100 Ton Locomotive	3½ Ins.	165

The Johnson Wrecking Frog Company
CLEVELAND, OHIO

RAMAPO

Automatic Safety Switch Stands Are Manufactured Only by the RAMAPO IRON WORKS

Write for descriptive catalogues on **Switch Stands, Switches, Frogs, Guard Rail Clamps, Etc.**

Manganese Track Work a Specialty

RAMAPO IRON WORKS

Main Office: Hillburn, N. Y.
Works: Hillburn, N. Y., and Niagara Falls, N. Y.

NON-CORROSIVE wooden water pipe is manufactured by The Michigan Pipe Co.

The pipe is steel banded, as shown. The steel bands are protected by a coat of imperishable asphaltum cement. The pipe is strong as steel with the resiliency of wood.

Some advantages of "Michigan Wood and Steel Pipe:

Will not corrode. — Protects water from freezing. — Less friction than metal pipe. — Withstands vibration without loosening the joints. — Withstands water hammer without bursting. — Withstands Hydraulic Pressure of 200 lbs. per sq. inch.

Many other advantages explained in our catalogue—write for it.

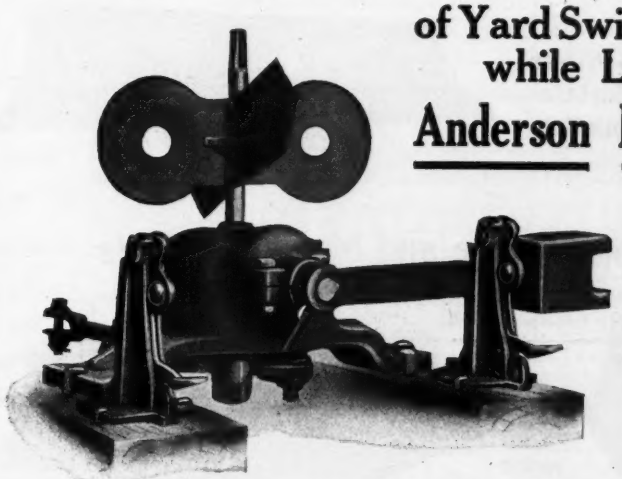
This pipe **lasts indefinitely,** and can be made as **strong as desired.**

THE MICHIGAN PIPE CO., Bay City, Michigan

$16\frac{2}{3}$ CENTS Maximum Maintenance Cost

of Yard Switches that are Run Through while Latched if you use the

Anderson Economy Switch Stand



This stand for yard switches, is provided with a special 3 way crank arm made of malleable iron. This 3 way crank arm is designed that when switch is run through, one of the arms to which the switch is connected will shear off, without damage, to any part of the switch mechanism.

The switch can be quickly placed in order by connecting the rod to one of the other arms. When the three arms are destroyed a new three way crank can be applied. These are furnished at 50 cents each. This feature is not new.

Over 30,000 Economy switch stands with this special 3 way crank, in service on many railroads.

Nonbreakable cranks are furnished for main line switches.

Full Details and Description of This Switch Stand in Our Catalogue. Write for It

MANUFACTURED EXCLUSIVELY BY

THE AMERICAN VALVE AND METER COMPANY

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THE MAMOLITH CARBON PAINT CO.

RAILROAD AND STRUCTURAL STEEL PAINT SPECIALISTS

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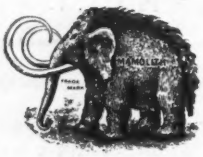
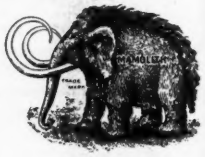
THE ONLY



Non-Corrosive Steel Protective Paint



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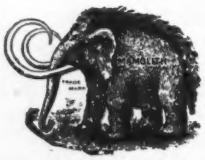

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and
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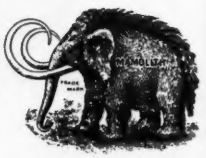
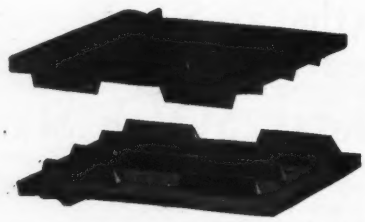


ATLAS RAIL JOINTS, TIE PLATES AND BRACES

ATLAS SWITCH STANDS AND CAR MOVERS



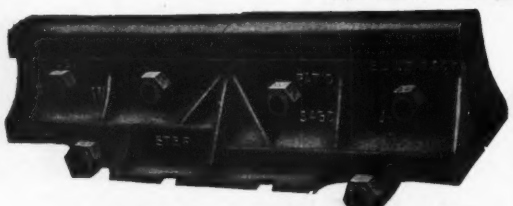
Top and Bottom View of Atlas Tie Plate

Atlas Primer and Surfacer for Your Cars

Atlas Standard Suspended Joint

Atlas Compromise and Insulated Joints

Made either of Atlas Special Malleable Iron or of High Grade CAST STEEL



Atlas Compromise or Step Joint
Made to Fit any Combination of Rails, Tee or Girder.

Made Either Suspended or Supported.

Atlas Insulated Joint

ATLAS RAILWAY SUPPLY COMPANY, 1523-7 Manhattan Building Phone Harrison 2900 CHICAGO

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ALL KINDS OF TANKS FOR FUEL OIL BURNING SYSTEMS

1,000 to 20,000 Gallon Tanks in Stock. Immediate Shipment.

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LOS ANGELES, CAL. 312 Security Bldg.

Maintenance vs First Cost — For One Gate Opening

The relation of maintenance to first cost as effecting final net returns from a given investment, is frequently not fully appreciated by railway officials who continue to use wooden gates. Why specify and buy four or five cheap gates to fill the same opening in ten years' time, spending the railroad's money (at least $25.00)—also claims paid for "stock killed"—also "continual repairs" on a gate that will not keep stock off the right-of-way, when for one-fourth of the amount railroads can purchase an American Self-Lifting High Carbon Steel Galvanized Gate that will settle the cost and expense for that opening forever? Note advantages of American Railway Gates.

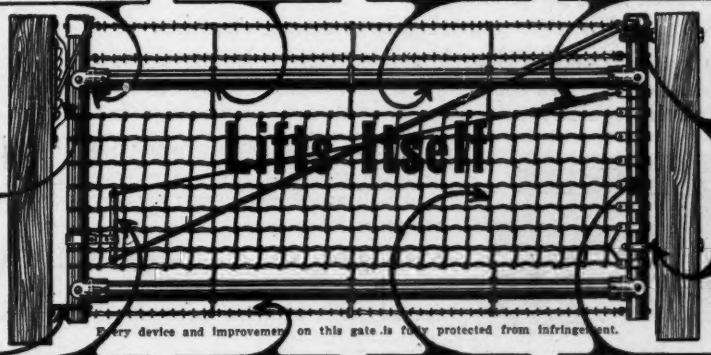
"Drags up Never Down." Horse High. Bull Proof. Fool Proof and Hog Tight. Painted or Galvanized.

Flexible Steel Couplings. Four flexible steel couplings allow the American Railway Gate to "give" without wrenching or twisting when stock crowds against the gate or loaded wagons strike it. No other gate has this flexible-coupling principle.

Connections. Flexible connections between the wire covering and steel frame turn and slip, but cannot be loosened by hard usage.

Tubing. Tubing is so strong no extra bracing needed. It is 2 inches in diameter; no other gate tubing is as large or strong.

Helical Lifting Spring. This powerful helical lifting spring is like the springs used on the best farm machinery in strength and quality. The coil wire used is baked, tempered in oil and galvanized, and will stand six times the strain of the gate.



Ratchet Lock. This ingenious ratchet-lock-and-loop locks the gate down close to the ground, or adjusts the gate when the ground is rooted up by hogs or "hove up" by frost, or when snow is deep.

Fork This hog-yard Fork holds the lower part of gate firmly; stock cannot wrench it out of place.

Bolted Caps. Caps are securely bolted to the frame. All couplings, caps and attachments, like the gate frame itself, are cold-rolled steel, pickled and limed—the highest quality steel made.

Hinge Lock-Nuts. Hinge lock nuts enable you to hang gate plumb, even if the post is out of plumb or uneven. Also 1-inch leeway for the hinge allows gate to rise or settle with freezing or thawing of ground.

Every device and improvement on this gate is fully protected from infringement.

Self-Lifting Equalizer. This automatic equalizer raises the end of the American Railway Gate when the ratchet lock is released. You do not have to lift the gate at all; it lifts itself. No other gate made has this self-lifting principle.

Hog Tight. Barbed wire close to ground and low position of bottom tubing makes it impossible for hogs to root under or through.

Wire Mesh. Note the closely woven wire mesh. Only finest quality American Steel & Wire Company standard wire mesh is used.

Ratchet Stretcher System. The horizontal wiring is tightened and kept rigidly in place by a ratchet stretcher system—the only true principle of tightening the heavy mesh hog wire. Even tension is insured by tightening each wire separately.

THE GATE THE FARMER WILL "KEEP CLOSED"—SO EASY TO OPERATE. WE CONTRACT AND SHIP EVERYWHERE. WRITE US FOR PRICES, CARLOAD OR LESS.

American Farm Gate Company, R. R. Dept., Kansas City, Mo., U. S. A.

H. L. GOODWIN, Vice-President and General Manager

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From Roadmaster to Superintendent

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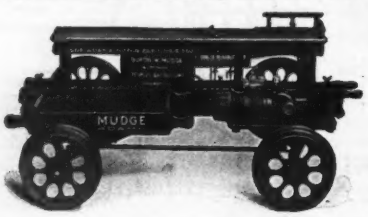

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Wilpen, Corning and Western Springs.

THREE serious railway collisions occurred during the month of July. As usual a renewed general discussion of railway equipment, construction and safety devices has been provoked. This discussion, which results in agitation for legislation, as far as the public press is concerned, deals with many phases of the equipment regardless of any connection or absence of connection with the causes of the accidents in question. The circumstances surrounding these accidents are fairly well known, but owing to certain garbled reports in the daily press it is thought best to give them briefly here.

At Wilpen, Pa., on the Ligonier Valley, a collision between a double-headed freight train and a passenger train consisting of one car ahead af the engine, occurred July 5. The circumstances surrounding this accident were such that there can be little benefit resulting from a study thereof. The Interstate Commerce Commission's report shows that on this branch no block signals of any kind were in use; that no train orders of record are used, the movement of trains being governed by the dispatcher in verbally given orders to the conductor; and that the road has no printed rules of any kind for the guidance of train men.

At Corning, N. Y., on the Delaware, Lackawanna & Western, a rear-end collision of passenger trains occurred July 4. This accident was by far the most serious in over two years, 39 passengers being instantly killed. Westbound passenger train, No. 9, made up of ten cars of both steel and wood, was blocked by a freight ahead. While standing with the protection of both home and distant block signals and the flagman, it was struck by express train No. 11. The rear car of No. 9 was built of wood, while the one ahead of it was of steel. The wooden car was completely destroyed.

At Western Springs, on the Chicago, Burlington & Quincy, a rear-end collision between an eastbound passenger train and an eastbound mail train occurred on July 14. Eastbound passenger train No. 2 was stopped by the manual block system signal at the tower at Western Springs. The engineer, however, on account of foggy weather, over-ran the signal by over a thousand feet. The operator then cleared the block west for the purpose of advancing the following mail train, No. 8, the length of the block to Western Springs. No. 8 is the fastest train on the road, and, just as had No. 2, and indeed, No. 4 earlier still, its engineer over-ran the signal, passing it at nearly seventy miles per hour. He discovered his mistake at the tower and attempted to stop, with the result that the rear end of No. 2 was struck at a speed of less than thirty miles per hour. The actions of No. 2's flagman are not well defined, but it appears that he placed two torpedoes too close in to be of any assistance in warning the engineer. No. 2 was made up of wooden cars, one of which was completely destroyed, thirteen persons being killed.

The Wilpen collision was due purely and simply to careless methods of operation. The conductor of the passenger train is held guilty of neglect in allowing his train to proceed beyond a meeting point said to have been designated by the dispatcher. As there is no record of such an order

having been given him, however, it becomes a question of veracity between conductor and dispatcher. Conditions invited accidents and until there is improvement in conditions on the Ligonier Valley, accidents of this nature are to be expected.

In the case of the Corning collision, agitators for the automatic stop could ask for no better ammunition than that furnished by the conduct of the engineer of No. 11 in running past two signals and a flagman. There was, however, no particular reason for taking special precaution at the point of this collision in laying out the signaling system. Automatic stops, if consistently located, would have had to be placed at each block signal if this collision was to have been prevented by their use. The flagman of No. 9 was unable to attract the attention of the engineer of No. 11, although he was passed by the latter at a point two thousand feet to the rear of his train, and in spite of the fact that he had used a fuse. This fact is partially accounted for in two ways. The morning was somewhat foggy and an injector on the engine of No. 11 had been causing trouble. In the inquest, the flagman testified that he used no torpedoes and stated as the reason that the signal officers objected to their use near automatic signals. This is a somewhat unusual excuse and the probabilities are that it is based on some trouble with circuits caused by the metal of exploded torpedoes and the resulting kicks of some maintainer. It did not develop that any instructions have ever been officially issued limiting the use of torpedoes on automatically protected tracks. The whole subject is interesting, however, in its relation to the accident and responsibility of the signal department. It was found that upon this occasion the signals were in perfect condition and the blame falls upon the engineer of No. 11. The design of the standard Lackawanna passenger engine is such that there can be practically no monitoring of the engineer by the fireman. The engineer's cab is located on the barrel of the boiler ahead of the firebox. In order to speak to him while the train is running at a high rate of speed, it is necessary for the fireman to walk out on the running board to the rear door of the forward cab. In the conversation the engineer must lean in from the window and turn around. The testimony in this case developed the fact that the signals and flagman were passed unseen for this reason, the bucking injector being the subject of the conversation. The arrangement of cars hauled in No. 9 has been condemned by authorities since the advent of the steel car. It is true that there is a difference of opinion as to the location of the heavier steel cars in a mixed train, but it has never been considered good practice to place a steel car between wooden ones, as was done in this case. The best practice in passenger train make-up, is, of course, to use only all wood or all steel cars. It is regrettable that this is not always possible. There are thousands of wooden passenger cars in the country which must be used, but whereas heretofore one or two steel cars have been made up in a train of wooden cars on account of the scarcity of steel equipment, now we are fast approaching a state of affairs when it will be only occasionally necessary to place a wooden car in a train otherwise all steel.

At Western Springs the question of the automatic stop again comes into prominence. Like that at Corning, however, the accident took place on a straight and level track. There was no particularly dangerous physical feature which called for special protection at either point. Automatic stops are conceded to be of value at dangerous crossings and the like and, no doubt, the future will see many applications of this nature. The manual block system of the Burlington is said to have been termed by its signal engineer, Mr. Latimer, the safest in the world. The fact that this road has commenced, since this accident, to install distant signals in connection with the tower boards, would seem to indicate that there was still room for improvement. It is, we believe, generally conceded among authorities that the Western Springs accident would have been prevented by a distant signal. This, in spite of the fact, as pointed out, that the distant signal did not prevent the Corning collision. On the morning of the Burlington's accident, three engineers in succession over-ran the tower board at Western Springs. Yet in each case the signal was noted and the stop made. This is pretty good evidence that the fault lies with the system and not with the men. The cars hauled in No. 2 were of wood. The destruction of the rear car was total, yet as demonstrated by the Odessa wreck, the steel car would have offered little greater protection for its passengers in an accident of this kind.

Centralia Hump Yard.

THE Illinois Central has practically completed the Centralia yards, described on another page of this issue. The article by S. S. Roberts, division engineer, is a very complete one, and gives some valuable data. It also shows the careful consideration given to the engineering and operating features before adopting the plans.

The arrangement of a good many yards in this country bears evidence of incomplete or careless preliminary plans. Some of them have simply "grown up," a track added here and there as needed. The result is that the operating department is put to a constant extra expense in handling cars.

A statement was recently made by a railway engineer who has been in charge of getting out the plans and doing heavy construction work on a number of large jobs, that thousands of dollars could have been saved on nearly every job on which he had worked if the plans had been completely worked out in advance. His experience has been that work on the plans is held up until there is a great hurry for new facilities. Positive orders are given to start construction work, and then work is rushed on the plans, the result being that they are not really completed until about the time the construction is completed. These conditions are responsible for frequent changes in the field which many times nullifies the usefulness of work costing thousands of dollars.

The development of any construction work should be made, if at all possible, in harmony with comprehensive general

plans. Even if the development of a yard is gradual, track by track, these may be located so as to be of final use in a development which can be efficiently operated.

Money carefully spent in planning is always more than compensated for by economies in construction and operation.

Center Tamping.

THE rule has been generally accepted that tie centers should not be tamped beyond about 15 inches from the rail, in gravel ballast, the idea being to prevent what is called center bound track. This rule is undoubtedly a good one in regular maintenance work. There is danger that the centers will be tamped up too stiff, causing poor riding track and broken ties.

There are many places, however, where we believe full center tamping is advisable. This will be on construction work mostly. When surfacing is done by contract there is practically no danger of getting the centers too well tamped, and where the lift is high, and the grade new, the settling of the roadbed will be the most serious feature and will entirely overshadow the effect caused by too stiff center tamping.

When making a lift of 5 or 6 inches out of face on a well settled grade, there is probably little to be feared from tamping centers too hard, but the work can, of course, be pushed faster if the centers are only lightly tamped.

In making a low raise with regular section men, it is undoubtedly good practice to tamp only part of the tie in the center, but on a soft grade, with a heavy lift and inexperienced or extra gang labor there would seem to be some question as to whether this is the best policy.

RAILWAY WAGES AND COST OF LIVING IN UNITED STATES AND EUROPE.*

Bureau of Railway Economics.

The Bureau of Railway Economics has completed the second of its comparative studies of railway conditions in the United States and the principal countries of Europe. This relates to the wages paid railway employees and the cost of living, and is based on the latest years for which comparative data are available.

The average daily compensation of railway employees of all classes for the year 1910 was in the United States, $2.23; in the United Kingdom, $1.05: excluding supplementary allowances negligibly affecting the average, it was in Prussia-Hesse 81 cents, and in Austria 89 cents. The lowest paid railway employee in the United States, the ordinary trackman, receives a greater compensation than many of the railway employees of France, even those of higher grades and with responsible duties. The compensation of railway employees is from two to three times as high in the United States as in Italy.

A recent report of the English Board of Trade on railway wages shows that the average weekly pay of enginemen in the United Kingdom in 1907 was $11.17; of firemen, $6.67. In the same year enginemen on American railways received an average weekly compensation of $25.80, counting six days to the week, and firemen $15.24. Recent returns make it clear that in 1912 enginemen and firemen in the United States are compensated at rates of pay for specific runs that are two, three and four times as high as the corresponding rates on representative English railways. The annual compensation of enginemen in the United States, as reported by two representative railway companies, now ranges from $1,100 in switching service to over $2,800 in passenger service, and of firemen from $700 in switching service to over $1,700 in passenger service.

For Continental Europe, official returns in requisite detail are not available for a later year than 1908. The salaries and allowances of the typical engineman in Germany amounted for that year to $646.88, in Austria to $870.80; of a fireman in Germany to $424.59, in Austria to $532.03. The annual compensation of enginemen on two of the principal railways of France ranged in 1908 from $505.66 to $906.91, and of firemen from $324.24 to $595.98. In Italy enginemen received in 1908, salary and allowances included, from $581.10 to $812.70 a year; firemen, from $330.30 to $475.05 a year. In these Continental countries the maximum compensation is received only after many years of service.

The average annual compensation of enginemen in the United States in 1908, on an estimated basis of 300 days' service, was $1,335; of firemen, $792. In this country the rate of compensation to these employees does not depend on length of service.

In Belgium enginemen received in 1907 from $23.16 to $38.60 a month; firemen, from $17.37 to $23.16 a month; conductors and station employees, from 46 cents to 96 cents a day. In the United States, in the same year 1907. enginemen averaged, on the basis of 25 days' service, $107.50 a month; firemen, $63.50 a month; conductors, $3.69 a day; station employees, from $1.78 to $2.05 a day.

The rental of a three or four room house or flat is almost as high in Berlin, Paris, or London as throughout the United States, but in England and on the Continent it generally runs from thirty dollars to ninety dollars a year less. The quantity of food and fuel estimated by the Board of Trade of England as the standard consumption of a typical workingman's family costs in the United States 17.8 per cent more than in France or in Germany; 35.3 per cent more than in Belgium, and 38 per cent more than in the United Kingdom.

It is well within the truth to estimate in a broad and general way that while the cost of living of a railway employee in the United States is less than 50 per cent higher than that of a corresponding employee in the United Kingdom or on the Continent, his compensation averages over twice as much.

* Condensed report of Bulletin 34.

The Atlantic, Waycross & Northern, it is said, will start soon on the extension projected from St. Mary's, Ga., northwest via Waycross and Fort Valley, to Atlanta, about 220 miles. The company now operates an 11-mile line from St. Mary's to Kingsland.

The Atchison, Topeka & Santa Fe has completed surveys for the cut off on top of the San Bernardino mountains and the construction work will commence shortly. The new line is between Cajon and Summit stations in Cajon pass and will be eight miles in length. Two tunnels must be built on the new line, which will be double track. The double track line from San Bernardino to Kennebrook, a distance of twelve miles, has been completed.

The Birmingham & Southeastern, according to press reports, will let contracts to build between Electric, Ala., and Equality. Work is now under way on an extension from Fort Davis northwest to Milstead, 40 miles.

The Birmingham & Southeastern Ry., W. M. Blount, president, Union Springs, Ala., is reported to be planning to let additional grading contracts for work between Electric and Equality.

Surveyors for the proposed railway from Metropolis, Ill., to Hickman, Ky., have completed preliminary lines over the entire route. The locating party started at Clinton, Ky., and is coming toward Hickman. It is rumored that the Chicago, Burlington & Quincy is interested in the movement.

Freight Yards at Centralia, I. C. R. R.

By Shelby S. Roberts, Div. Engr. of Construction.

The business of The Yazoo & Mississippi Valley R. R., the main lines of the Illinois Central R. R. from New Orleans, the Birmingham line, most of the traffic from the Kentucky division, and nearly all of the traffic from the Southern Illinois coal fields concentrates on the main line of the St. Louis division south of or at DuQuoin, Illinois.

Thirty-eight miles north of DuQuoin, at Branch Junction, is the point of separation of the traffic from the South to Chicago and the Northwest. The freight trains passing north through DuQuoin are made up from contributions from all the sources mentioned above and are in through carload lots that must be separated somewhere between DuQuoin and Branch Junction. Owing to the character of the freight, when this separation is made, it is entirely practicable to further classify the freight so that full trains may be made up, say, for Wildwood, Fordham, Water Street and Hawthorne Yards, Chicago, for Peoria, Freeport and Northern and Western points. These trains will require no further switching en route except the changing of engines and cabooses at engine district terminals and the possible reduction or filling out of tonnage due to grades or weather conditions on the several districts.

Such classification south of Branch Junction will relieve the increasing congestion and reduce the switching in all yards north of that point and will consequently make possible a somewhat quicker delivery of freight to the points of consignment.

At the present time the Chicago and the Northwestern freight is separated in tail switching yards located between Centralia and Branch Junction, while the engines from St. Louis, Freeport and Illinois divisions, which terminate here, are taken care of in a round house and by mechanical facilities located just south of the passenger station at Centralia. For the present business the old facilities are inadequate, and are so enclosed by Centralia and Central City that enlargement is impossible.

Because Centralia is a division terminal, because of inability to expand at the location of the old yards and because of the location of the mechanical facilities, the operating officers selected territory immediately south of Centralia for the location of new yards, and because of the possibilities of classification, previously outlined, and the volume of traffic, they also decided to build a summit or hump yard.

The new yards, now nearing completion, are located on the west side of the old right of way between the village of Irvington and the southern limits of Centralia, and cover a strip of land five hundred feet wide in addition to the old right of way, comprising approximately two hundred and seventy-five acres.

Early in 1911 when the operating officials decided upon the construction of these yards, the property on both sides of the then existing main tracks between Centralia and Irvington was cross-sectioned for a distance of 600 feet on either side of the main tracks. These preliminary surveys developed that the formation of the ground west of the main tracks was better adapted for economical construction purposes than that lying to the east. Consequently all later efforts were concentrated upon the development of the property on the west side.

All plans were based on the following requirements: the general scheme to separate the main tracks and build the yards between them in order to permit free interchange between the yards for north and for southbound traffic without the necessity of yard movements crossing or opposing the movement of trains on either main track; all body tracks to be of the same length, and they, together with all lead tracks, to be of sufficient length to hold a train of eighty cars, an engine and caboose; the grades of all tracks, in the direction of their length, to be governed, as far as physical and other conditions will permit, by the service for which the tracks are intended; all yards in addition to have cross grades to facilitate surface drainage; the distance center to center of body tracks to be not less than thirteen feet to make the operation of the yard safer and the main tracks to be separated five hundred and fifty feet to permit present construction and a liberal provision for future development.

Keeping these facts in mind, the first plan was as outlined by the accompanying sketch.

This plan contemplated building a twin hump, one side for north and the other for southbound classifications, between two exactly similar yards, each offering a future development to thirty-two tracks, and so connected to the hump that any portion of either yard might be used as a receiving or a classification yard as the preponderance of traffic fluctuated. Between these two yards and west of the hump is a third yard for light repairs, which yard included provision for a machine shop, mill building, car repair sheds, yardmaster's office and power house.

Considering the apparent concentration and elasticity of operation of this plan, the central location of repair tracks and buildings, the first impression of it is most favorable. However, upon analysis the concentration and elasticity are myths. There is much waste space. No provision is made for sufficient open or thoroughfare tracks. Even with the acceptance of very heavy work, the best approach grades to either side of the hump are very steep. The grading is entirely a borrow proposition. And, in the event it should become expedient for any reason to locate a round house and accompanying mechanical facilities in the vicinity of the new yards, there is no place between the main tracks where this can be done. The plan was rejected.

The operating department at this time decided that southbound classifications at Centralia were not sufficient to now warrant the construction of a hump to care for southbound business, and the engineers were set to work on other study plans to accomplish the general schemes first named with these further instructions.

Provision must be made for a receiving, classification and departure yard for northbound traffic; a tail switching yard for southbound traffic with two lead tracks so located that they may form part of a future receiving yard and permit the construction of a hump under them without interference with other facilities, should future conditions justify it; provision must be made for a future yard to be used as a departure or as a tail switching yard for southbound traffic or both; space must be set apart for a repair yard, an engine yard, a fifty-stall round house and accompanying facilities; and the grades must be so laid that the excavations shall make the embankments.

The adopted plan and profile upon which the yards are being constructed are shown in the accompanying cut entitled, "Adopted Plan and Profile."

This plan, it is believed, fulfills the specifications, and in addition effects a considerable saving in first cost over the "First Plan." The grading and masonry work for the entire development of the adopted plan may be done for the same or slightly less than what present construction of the first plan was estimated to cost. The approach grade to the hump is only four-tenths of one per cent. Ample open or thoroughfare tracks are provided, a point upon which practical yardmen lay great stress.

The following comparative approximate statements give a fair idea of the scope of the work and plans for present construction and future complete development:

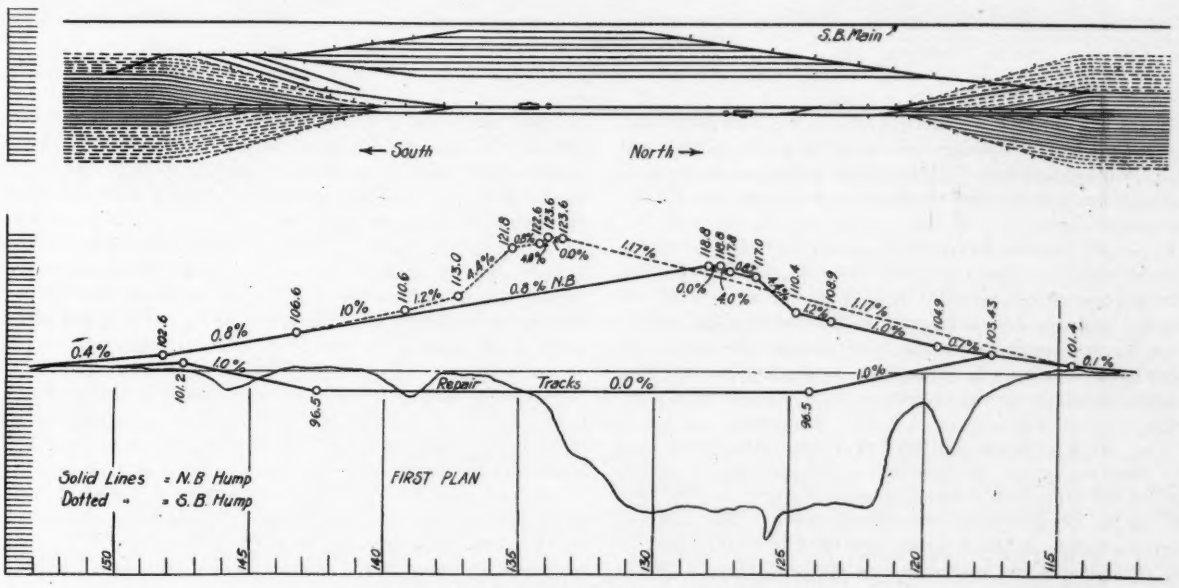
CAPACITY OF YARDS.

	Present Construction.		Complete Development.	
Northbound traffic:	Tracks.	Capacity in Cars.	Tracks.	Capacity in Cars.
Receiving yard	5	400	17	1360
Classification	17	1360	33	2640
Departure	0	0	16	1280
Caboose tracks	2	100	3	100
	24	1860	69	5380
Southbound traffic:				
Receiving	2	160	8	640
Classification	12	960	16	1280
Departure and tail switching	0	0	20	1600
Caboose tracks	2	66	2	66
	16	1186	46	3586
Miscellaneous:				
Repair yard	0	0	9	323
Engine yard	3	91	13	296
Total	43	3137	137	9585

The foregoing represents the capacity of tracks in the clear upon which cars may be stood in the normal operation of the yard, and does not include lead, ladder and thoroughfare tracks.

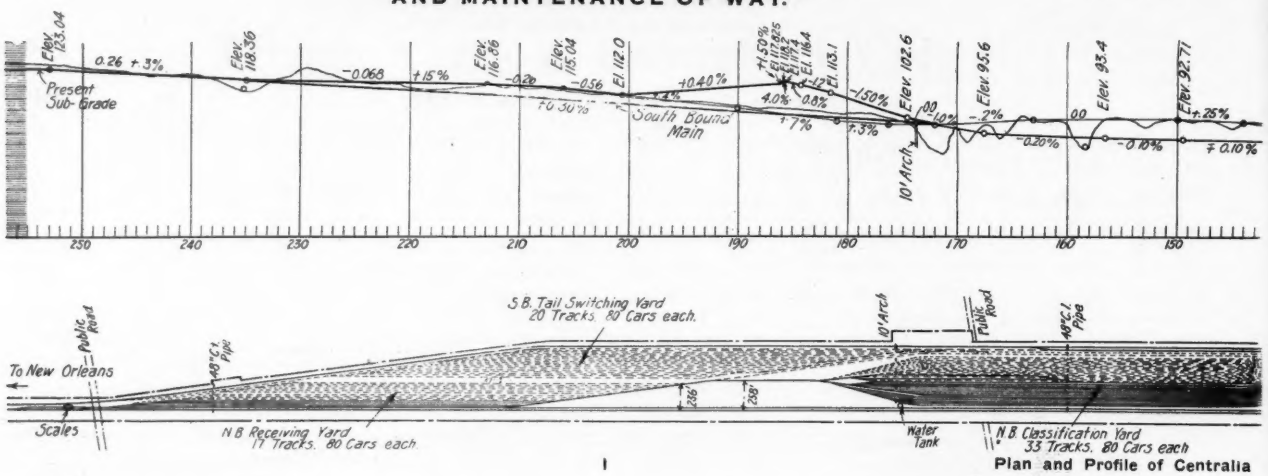
VOLUME OF WORK AND NUMBER AND CHARACTER OF BUILDINGS.

	Present Construction.	Complete Development.
Right of way	275 acres	275 acres
Grading, excavation	440,000 cu. yds.	780,000 cu. yds.
Culverts, concrete	5,700 cu. yds.	9,800 cu. yds.
Concrete pipe	1,100 lin. ft.	1,500 lin. ft.
Sub-surface drain tile	20,000 lin. ft.	40,000 lin. ft.
	Miles.	Miles.
Main track	4.9	4.9
Yard tracks	25.4	76.9
Ladders, leads, etc	11.1	14.2
Total tracks	41.4	96
Frogs and switches	124	324
Track scales	2	3
Water works:		
30,000-gal. tank	1	1
100,000-gal. tank	0	2
Penstocks	1	4
Fire-protection system	1	1*
Locomotive coaling plant	1	1
Inspection pit	0	1
Cinder pits	0	3
Locomotive crane	0	1
Buildings:		
General yard master's office	1	1
Asst. yard master's office	1	1
Asst. yardmaster's and scale office	1	1
Scale house	1	2
Car repairer's houses	3	5
Tower for elect. switch machine	1	1
Air compressor house	1	1
50-stall round house (100-ft. stalls)	0	1
Machine shop	0	1
Oil house, tank, pumps, etc	0	1
Power house with cinder pit and chimney	0	1
Store room and office	0	1
Dry sand storage bin	1	1
Sand bin and dryer	1	1
Rest room and toilet	0	1
Turntable pit and 85-ft. turntable	0	1
Sanitary range toilets	0	2
Material shed	0	1
Material shed with offices	0	1
Car repair shed	0	1
Wood mill	0	1
Electric lighting, telegraph and telephone system	1	1*
Gasoline car to return riders to hump	1	2



First Proposed Plan, Centralia Yards, I. C. R. R.

*Extended.



Plan and Profile of Centralia Yards,

There is a decided difference between the adopted grades descending from the hump and those proposed on the first plan. An explanation of this change would seem pertinent and a discussion of hump grades in general may be of some interest.

It is well known that a grade giving satisfactory results for one season of the year is not so for other seasons and that grades giving excellent results in one section of the country will not be satisfactory in another section remote from the first, even during the same season. In short, even for a given locality it is impossible to calculate exactly what a grade should be or the velocity a car will attain on a given grade.

The rolling of a car will depend, among other things, on the temperature, on the type of car, whether flat, box, ore, etc., in the same type whether loaded or empty, on the time the car has been standing immediately prior to being pushed over the hump, on the direction and velocity of the wind, on the curvature in the tracks and on the proficiency of maintenance of equipment and of the track.

A few facts that are pertinent and developed from experience are:

1. The hump where empties predominate should be higher and there should be steeper grades in the body tracks than where loads are in the majority.

2. The order of rate of grade should be:

(a) A short steep grade to the scales.

(b) A light grade over the scales.

(c) A heavier grade to and through the ladders.

(d) A grade, for a portion of the length of the body tracks, of sufficient magnitude to just overcome the rolling resistance of the car, so that the car will continue to move at the speed at which it entered the body track.

(e) A level grade or an ascending grade at the departure end of the yard of sufficient length and magnitude to about bring the car to a stop near the end of the yard.

The above statements will doubtless be held incomplete and of little value for the reason that the rates of grade to be employed on the five different sections are neither given nor recommended.

It would be of less value if in so general a statement rates of grade were given. The statement would then be misleading as well.

An interesting statement of actual practice in a number of yards is given in the accompanying table.

This table, with the exception of column 8, is taken from page 167, volume 7, of the Proceedings of the American Railway Engineering and Maintenance of Way Association for 1906, and is a part of a paper by Mr. W. C. Cushing, chief engineer maintenance of way, Pennsylvania Lines, Southwest System. To it have been added similar information concerning the Dupo yard of the Missouri Pacific Railway, the Dolton yard of the Chicago & Eastern Illinois Railroad, and the proposed Centralia yard of the Illinois Central Railroad. As Mr. Cushing states, the speeds given in column 5 are probably about correct. Those in column 8 are doubtless greater than actually attained in the operation of these yards, because in the theoretical computations no account has been taken of the resistance of the lead curves or that encountered on the ladders on account of the guard rails, frogs, etc. The method employed in computing these speeds is that of Raymond, Webb, or the late A. M. Wellington. No account is taken of the initial speed of the car over the summit of the hump and an averaged rolling resistance of 8 pounds per ton is assumed, which is equivalent to a grade of repose of 8/20 and equals 0.40 per cent, which call "r." The grade producing speed equals the actual rate of grade, which call "R," minus the grade of repose and is equal to R—r. This "speed grade" multiplied by the horizontal length of the grade in stations of 100 feet, which call "L," equals the velocity head, which call "H," or it is the vertical height through which a body falling freely would have to fall to attain the same speed the car should have at the foot of the grade. The velocity head is therefore equal to H equals L (R—r). From the ordinary formulas of elementary mechanics for falling bodies increased by 4.63 per cent to allow for the energy of the rotating wheels, it may be shown that H equals $0.035 \times S^2$ where S equals the speed in miles per hour. From the foregoing:

$$S^2 = \frac{H}{0.035} = \frac{L(R-r)}{0.035}$$

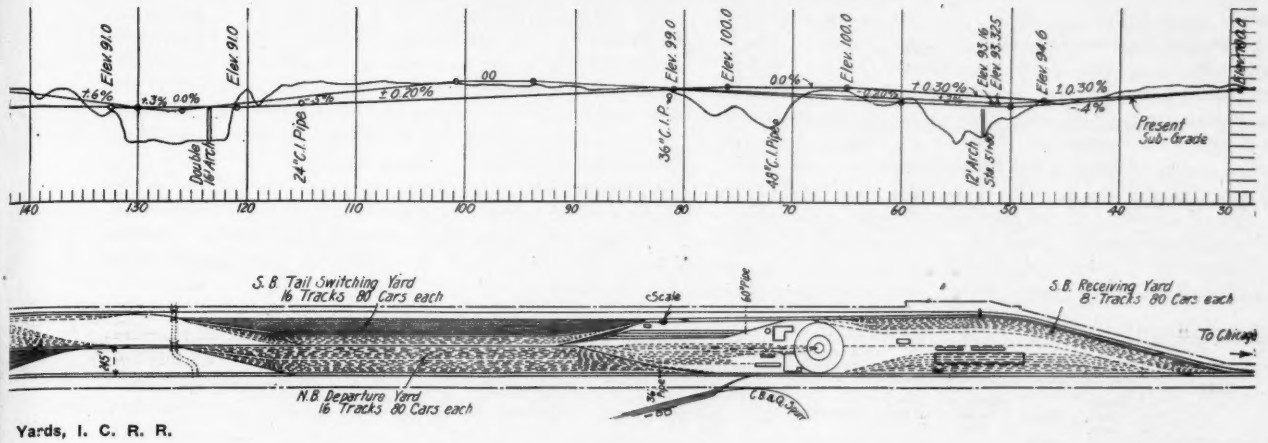
Without solving this equation, having the value of H, the corresponding speed may be taken from tables to be found in the works of either of the authorities named above.

The above explains how the values given in column 5 of the table were computed. For the values in column 8 the assumption is made that the speed at the foot of the first grade, as given in column 5, is the initial speed at which the car is moving when it starts to descend the second grade.

Considering the grades independently, the velocity head for the first grade may be called H_1. That for the second grade H_2, then the velocity head for the descent to the foot of the second grade is $(H_1 + H_2) = H_3$, and the corresponding speed is

$$S_3^2 = \frac{H_1 + H_2}{0.035} = \frac{H_3}{0.035}$$

which gives the same speed at the foot of the second grade, whether the grades are taken together or separately.



Yards, I. C. R. R.

The explanation of the method of computing the values given in columns 5 and 8 has been given in detail for the reason that the writer had to change all of the values given in the original table in column 8, because of a serious error therein. This may be shown as follows: In any mechanics there will be found expressions similar to these:

(1) $2AH = S^2$, meaning twice the acceleration times the distance traversed is equal to the square of the speed attained by the body. And where the body has an initial speed

(2) $2AH_2 = S_3^2 - S_1^2$

By transposing—S_1^2 we obtain

(3) $2AH_2 + S_1^2 = S_3^2$

which signifies that twice the acceleration times the distance traversed plus the square of the initial speed is equal to the square of the final speed.

In our case the acceleration is that due to gravity.

H_1 is the vertical fall of the first grade diminished by the amount necessary to overcome resistances.

H_2 is the same function for the second grade and H_3 is that for both grades.

S_1 is the speed at the bottom of the first grade and S_3 the speed at the bottom of the second grade or the final speed. Equation (3) becomes

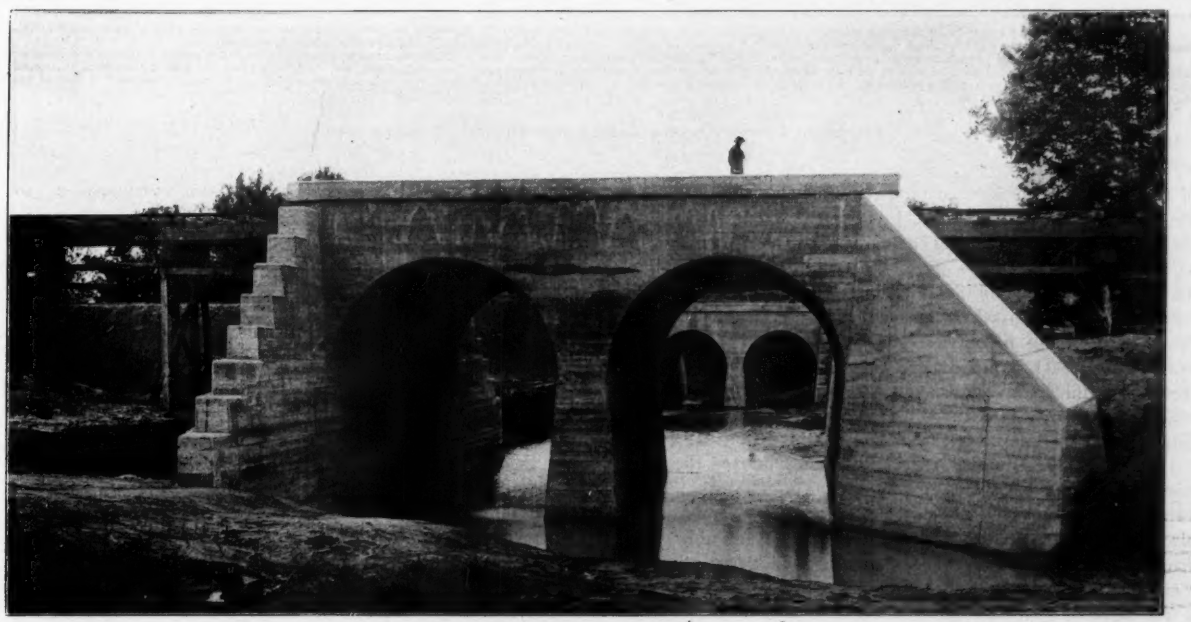
(4) $2gH_2 + S_1^2 = S_3^2$ but $S_1^2 = 2gH_1$ therefore

(5) $2gH_2 + 2gH_1 = S_3^2$ or $S_3 = \sqrt{2g} \cdot \sqrt{H_1 + H_2} = \sqrt{2g} \cdot \sqrt{H_3}$ and is not $\sqrt{2g}\ [\sqrt{H_1} + \sqrt{H_2}]$ as used in computing the values for column 8 of the original table. The above gives results in feet per second. To express results in miles per hour:

(6) $S_3 = \sqrt{\frac{H_1 + H_2}{0.0035}} = \sqrt{\frac{H_3}{0.035}}$

The original table in line 1, column 8, gives the final speed as 19.4 miles per hour. In columns 3 and 6 the total fall, undiminished on account of resistances, is 9.2 feet. If the car in question, starting from rest, were to fall freely in a perfect vacuum through a vertical distance of 9.2 feet, it could acquire a speed of only $\sqrt{2 \times 32.16 \times 9.2}$ feet per second, which is equal to $3600 \div 5280\ \sqrt{2 \times 32.16 \times 9.2}$ equals 16.58 miles per hour, which is a short method of showing the error of the original table.

The grades shown on the first plan were fashioned after those of the Dupo yard of the Missouri Pacific Railway and the Dolton yard of the Chicago & Eastern Illinois Railroad, so as to be in a manner a mean between the two. However, since the actual speed developed by cars on these humps seemed excessive and as it required a car rider or dropper



Double 16-foot Concrete Culvert at Centralia, Ill., I. C. R. R.

on each car, the cost of operation was judged to be higher and the possibility of damage to cars and contents appeared to be greater than would obtain on hump grades of approximately the same vertical fall accomplished in a greater horizontal distance as is the case in the adopted plan. This conclusion was drawn after watching the successful operation of the Youngwood yard of the Pennsylvania Railroad at Youngwood, Pa. (the rates of grades of which in late reconstruction were reduced to a less rate than that shown in the table), and after obtaining the opinions of a number of old yard men and experienced men in operating departments. After the rearrangement of grades at Youngwood a considerable saving in operating expenses was effected, which was partly attributable to the installation 1° 01′, while there are gained the advantages of practically a 12° instead of a 16° lead curve and a saving of practically 3.2 lbs. per ton in resistances. All main track connections are made with No. 10 turnouts, except where the new southbound main leaves the old main line at the north end of the yard. Here a No. 18 turnout is used to permit higher speeds than permissible with a No. 10, and also in order to maintain the alignment of the new main track.

A further point of considerable discussion was the choice of the kind of ladder to use at the entrance to the classification yard. In making this selection the following types of ladders were considered, the claims for and against which are also stated.

YARD	First Grade From Summit				Average Remaining Grade From First Grade to Bottom of Ladders			Grade of Ladders Per Cent	Grade of Classification Yard Per Cent	First Grade From Scales When Any Per Cent	Distance From Summit to Center of Scales Feet	Standing Car Capacity All Yards	Character of Traffic
	Grade Per Cent	Fall Ft.	Horizontal Length Feet	Velocity at Foot M. P. Hr.	Fall Ft.	Horizontal Length Feet	Velocity at Foot of Ladders H. P. Hr.						
	2	3	4	5	6	7	8	9	10	11	12	13	
Enola.....E.	3.5	4.2	120	10.2	5.	500	13.9	1.0	0.1	None	.....	10,705	Coal.
Enola.....W.	3.5	3.5	100	9.3	10.	700	17.2	1.4	0.3	None	.....	.....	Empties.
Altoona.....W.	3.9	5.8	150	12.2	13.8	1,500	19.3	0.92	0.29	None	.....	10,500	Empties and mdse.
Harrisburg.....W.	3.6	5.4	150	11.6	14.6	1,100	20.7	1.5 & 1.2	0.0	None	.....	10,015	Empties and mdse.
Conway.....E.	2.5	5.5	220	11.4	15.	2,800	15.5	0.5 & 0.3	0.3	0.83	250	.....	Ore, grain and mdse.
Conway.....E.	3.0	6.3	210	12.4	13.	2,000	17.3	1.0 & 0.3	0.0	1.80	350	8,967	Ore, grain and mdse.
Conway.....W.	1.8	8.6	480	13.7	8.4	1,800	15.0	0.6	0.14	1.80	220	.....	Coal, coke and mdse.
Granville (mdse.).....E.	2.5	1.3	50	5.6	.....	.....	.....	1.0	1.0	None	.....	7,842	Merchandise.
Granville (coal).....E.	2.0	1.0	50	4.8	.....	.....	.....	1.0	1.0	2.0	100	.....	Coal.
Columbus.....E.	2.0	4.8	240	10.4	9.	1,000	15.9	1.0	0.8	2.5	280	.....	Mdse., grain and empties.
Columbus.....W.	2.5	8.8	350	14.4	7.5	750	18.4	1.0	1.0	2.5	190	3,402	Coal, coke and mdse.
Alexandria.....N.	2.5	2.5	100	7.7	11.5	900	16.9	1.0	0.35	2.0	170	.....	
Alexandria.....S.	2.5	2.5	100	7.7	13.5	1,100	17.9	1.0	0.30	2.0	170	3,127	Mdse. and produce.
Edgemoor.....N.	1.54	0.8	50	4.0	.....	.....	.....	1.5	.....	1.5	80	.....	
Edgemoor.....S.	1.0	0.7	70	3.5	5.25	300	11.3	1.75	0.0	1.75	80	2,819	
Logansport.....E.	2.4	3.0	125	8.4	7.	800	13.4	0.5	0.04	On Summit	.....	.....	Mdse., grain and empties.
Logansport.....W.	1.45	3.6	250	8.6	2.	450	8.9	0.43	0.4	On Summit	.....	2,124	Mdse., coke and coal.
Crestline.....W.	3.0	7.5	250	13.5	2.	400	14.0	0.75	0.3	None	.....	1,784	Mdse., coke and coal.
Marysville.....E.	2.5	6.5	260	12.4	12.	1,000	19.6	1.2	0.0	2.5	110	.....	
Marysville.....W.	2.0	4.6	230	10.2	8.4	700	16.3	1.2	0.36	None	.....	1,756	
Scully.....E.	2.5	2.5	100	7.7	13.	1,000	17.8	1.3	0.5	2.5	150	1,740	Coal.
Bradford.....W.	3.0	2.4	80	7.6	3.2	700	8.4	0.45	0.45	None	.....	1,715	Coal, mdse. and empties.
Ebenezer.....N.	1.75	14.9	850	18.	0.0	0	18.	1.75	0.57	1.75	120	1,620	
Chicago, 55th St.....E.	3.0	4.5	150	10.5	3.5	700	11.5	0.5	0.17	0.5	330	.....	Mdse., grain & empties.
Chicago, 55th St.....W.	3.0	4.5	150	10.5	3.5	700	11.5	0.5	0.5 & 0.05	0.5	400	1,278	Mdse and coal.
Honey Pot.....W.	2.0	0.8	40	4.2	5.	500	10.2	1.0	0.12	1.2	90	1,194	Coal.
Sheridan.....E.	1.67	2.5	150	7.3	6.	700	12.1	0.74	1.0	1.55	170	1,103	Coal.
Richmond.....W.	2.5	2.5	100	7.7	2.	400	8.4	0.25	0.25	None	.....	745	Merchandise.
Linwood.....W.	3.0	3.	100	8.5	4.	400	12.0	1.0	0.0	On Summit	0	656	Merchandise
Mansfield.....E.	2.5	3.2	130	8.7	4.	600	11.1	0.2	0.2	1.0	250	.....	Mdse. and empties.
Mansfield.....W.	2.5	5.	200	10.9	2.5	400	12.1	0.2	0.2	None	.....	630	Mdse and Coal
Chicago, Clear N & S.	2.5	5.	200	10.9	19.8	2,200	19.4	0.9	0.0	None	.....	14,000	Not in use.
Youngwood.....W.	1.74	1.4	80	5.6	.....	.....	.....	1.3	0.3	2.0	120	.....	Coal and coke.
Holidaysburg.....	2.0	1.0	50	4.8	.....	.....	.....	2.0	0.9	2.0	100	.....	Coal.
Waverly.....	1.5	9.	600	13.6	.....	.....	.....	1.5	0.5	None	.....	.....	
DeWitt.....E. & W.	1.0	2.5	250	6.5	.....	.....	.....	.....	.....	None	.....	.....	
Winnipeg.....E. & W.	3.7	11.1	300	16.7	.....	.....	.....	.....	0.0	On Summit	0	.....	
Elkhart.....E.	4.3	12.9	300	18.3	.....	.....	.....	.....	0.16	.....	.....	.....	
Elkhart.....W.	5.0	15.	300	19.9	.....	.....	.....	.....	0.18	.....	.....	.....	
Dupo, Ill.....N.	4.0	0.6	15	3.9	21.2	1,125	22.2	1.20	0.4 & 0.0	5.00	6.5	.....	Merchandise.
Dupo, Ill.....S.	4.0	0.6	15	3.9	21.2	1,125	22.2	1.20	0.4 & 0.0	5.00	6.5	.....	Merchandise.
Dolton, Ill.....N.	1.92	2.01	105	6.7	12.91	1,125	16.9	1.5 & 0.5	0.0	3.00	162.5	.....	Mdse. and coal.
Dolton, Ill.....S.	3.00	3.00	100	8.6	16.50	1,300	19.9	1.0 & 0.67	0.0	3.00	150.0	.....	Mdse. and empties.
Centralia, Ill.....N.	4.00	1.00	25	5.1	21.60	1,775	21.0	1.5 & 1.00	0.1 & 0.2	4.40	75.0	3,360	Mdse. and coal.
Centralia, Ill.....S.	4.00	1.00	25	5.1	20.22	1,625	20.4	1.5 & 1.00	0.2	4.40	75.0	2,240	Mdse. and empties.

In calculating columns 5 and 8, the following data was used: A single loaded car weighing 150,000 lbs.—75 tons; rolling friction—8 lbs., per ton; grade acceleration—f—20 x rate of grade per cent. (Wellington p. 340); grade of repose, or grade to balance resistance to motion—0.4% "Wellington's Railway Location," p. 335, Table 118. No initial velocity included in column 5.
The apparent inconsistency between the results given by the last two lines of the above table and statements made elsewhere of the requirements of humps for loads and empties is, there is twice as much curvature in the ladder for Centralia's north-bound as for the south-bound yard and there are steeper grades on the body tracks of the south-bound yard. It is known that the speed at the foot of the second grade will be less than that in column 8 and it is believed the actual speed will be reduced more for the north than for the south-bound yard on account of the conditions mentioned, therefore it is believed the inconsistency is only apparent and not real.

Tabulated Summary of the Grades of a Number of Hump Yards.

of an adjustable mechanical hump and a new type of 150-ton one-track track scales, and largely due, in the writer's opinion, to the readjustment of grades below the scales. On the readjusted grades the cars do not attain high speeds immediately below the summit of the hump. A car rider might in safety flip a car anywhere on the hump or might hold the first car of a cut below the scales by means of the hand brakes, until each car had been separately weighed and collected by him again into a continuous coupled cut and then taken on as such into the classification yard. In fact one rider is able to handle a cut of from twelve to fifteen cars.

In the past the Illinois Central Railroad has used the number seven frog very generally in yard work. With the advent of larger engines of long rigid wheel base and the desire to reduce curvature and curve resistance number eight frogs are used for all yard turnouts and cross-overs at Centralia.

The loss of space as between the use of No. 8 instead of No. 7 frogs is not great, the difference in angle is only

These types are used in small or medium size yards up to yards, say, of 16 or 18 tracks.

The advantages claimed for type "A" are:

(a) Straight alignment of body tracks;

(b) Clear view of switches;

(c) Adaptability to cross grades in the body of the yard.

This type permits holding a uniform grade on the body tracks together with a steep grade on the ladder. The body tracks may be kept the same length by the use of a fish tail ladder or a "B" type ladder at the departure end of the yard.

The type "B" ladder occupies the same space in length and breadth of yard for the same number of tracks as type "A." The claim to supremacy made for type "B" ladders is, fewer switch tenders are required.

From a careful study of the above sketches, it is observed that there might be such a number of tracks that "B" could be operated with one less switch tender than "A." This not always, but sometimes. The same inspection, however, will also develop these facts:

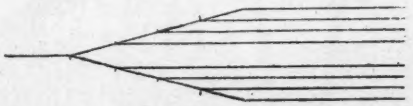
(a) There is twice as much curvature in "B" as in "A";

(b) "B" does not permit of as logical an arrangement of cross grades as "A."

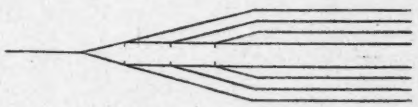
Some maintain that the increased curvature makes no difference. Practical yard men say the curvature is a disadvantage. That it intimidates the car riders under certain circumstances and retards rapid movement of the trimming engine. From an engineering viewpoint it would appear objectionable because of increased rail wear and the increased rate of grade necessary to overcome the greater curve resistance.

Types "C" and "D" occupy the same space as either "A" or "B" and have the same total curvature as type "A," but differently distributed, advantage being given to one-half of the yard. Of the two, "C" seems preferable to "D." In a yard where traffic is such that certain trains are made up chiefly of empties and certain other trains chiefly of loads, the type "C" might be used to advantage. The empties may be classified in the side of the yard having less curvature (less resistance) and the loads in that side having greater curvature (greater resistance). Thus, even with a uniform profile grade one hump may, in a manner, give control over the difference in tendency of the load and empty to roll.

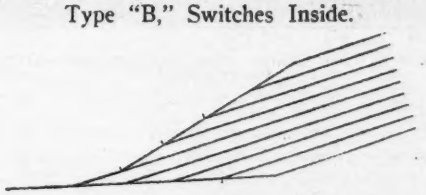
Double Ladder at the Frog Angle.



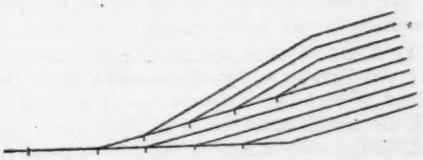
Type "A," Switches Outside.



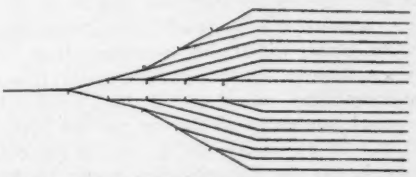
Type "B," Switches Inside.



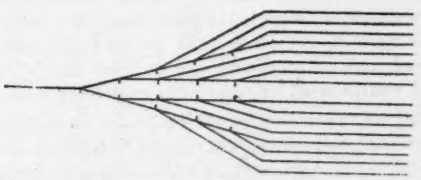
Type "C," Switches Outside.



Type "D," Switches Out and Inside.



Type "E," Switches Out and Inside.



Type "F" All Switches Inside.

These are the types of ladders generally found in very large yards of more than 18 and up to 32 tracks, beyond which number of tracks it is hardly deemed advisable to go in one group of tracks. In both these types curvature is accepted to economize space and to keep the switches near the hump. The curvature is the same in each, but more advantageously located in "E."

The ladder at the entrance to the classification yard of the adopted plan is a combination of types "A" and "E" that it is believed will prove more satisfactory than "E."

In the actual grading and masonry work at Centralia there are no unusual features. Slips and wheel scrapers were employed in making the channel changes. Where the haul permitted, wagons loaded by team and traction grading machines were used and in the longest and deepest cuts where the haul was long, steam shovels with dump cars propelled by locomotives were made use of. In constructing the large fills made from the steam shovels a trestle was first constructed from which material was dumped until the embankment reached the height of the ties. The embankment was then made by dumping over the side and widening by means of an air-operated spreader. The track on the trestle was thrown following the top of the bank, the stringers and caps of the trestle were pulled and the bank completed by filling under the traffic of the dirt trains. Shrinkage varying from 5 per cent to 12 per cent was used depending on the depth of the filling and whether the fills were made by teams or steam shovels.

At the busiest time during the work there were five steam grading outfits at work, and three steam shovels, two serving standard gauge twelve yard Western air dump cars and one serving a dinky outfit with three yard hand dump cars.

The masonry work consisted of the extension of an eight foot arch culvert, and the construction of two ten, one twelve and two double sixteen foot arch culverts. The concrete for the eight foot arch was mixed by hand. That for the remainder of the arches was mixed by machines. The material was unloaded from spur tracks, built near the site of the arches, mixed and dumped into small steel dump cars which were carried on trestles over the work to the point of deposit within the forms. The principal culvert is the double sixteen foot arch shown in the illustration.

This picture shows the temporary trestle built by the grading contractor, but unfortunately for the purpose here used, the masonry contractor's trestle had been removed before the picture was made.

As the excavation for the north bound classification yard progressed the unexpected wet character of the material encountered made necessary the installation of a system of sub-surface drainage. This is composed of 6-in., 8-in., 10-in. and 12-in. farm drain tile laid parallel to the tracks and in each alternate space between the tracks with 8-in. cast iron cross lines where the drainage is carried under the tracks.

The north bound receiving and departure yards, the south bound departure yard and repair yards have a cross fall of one-tenth foot per track from East to West. The South bound receiving, classification and the engine yards have the same rate of cross fall from West to East, while the North bound classification yard has same rate of cross fall in both directions from the center. The profile grade of

the classification yard represents the grade of the outside tracks. The track through the center of this yard is one and six-tenths feet higher.

The grading, masonry work and the erection of the locomotive coaling station is contract work. The remainder of the work is being done by the railroad company's forces.

Should the method of operation of the yards prove of interest it may be said that it will follow that generally employed in hump yards which is as follows:

A train arrives and is admitted to the receiving yard. The road engine cuts off and goes to the round house, while the conductor takes his bills, etc., to a yard clerk's office near the receiving yard, where the bills are checked and cards are prepared showing the routing of the individual cars. The "carder" then "cards" the train, which in the meantime has been inspected, special attention being paid to the condition of the hand brakes. This done, the hill engine sets off the caboose and pushes the train over the hump. At the summit a "marker" marks with chalk on the front end of each car, or the first car of each cut, the number of the classification track to which the car is assigned and on the end or side of the car near the end, the number of the track to which the next following car or cut should go. These numbers are for the guidance of the tower man who throws the switches. As a car or cut approaches the summit, it is uncoupled from those following. A short steep grade, called the "bunching grade, right at the summit assisting in this. As the car passes the summit, it is mounted by a car "rider" or "dropper," whose function is to so control the speed of the car by the hand brakes that there shall be no damage to the car or contents when it couples to the car that has preceded it into the classification yard. The movement of the hump engine is governed by the hump foreman by means of a high semaphore signal, and in addition a whistle located near the summit. A signal having three positions will be used, one position to come ahead, one to stop and one to back up. A gasoline motor car will be used to return the car riders to the hump.

While all of the above is taking place the bills are sent to the general yard office, where such information is taken off or added as is necessary and the bills are forwarded to a yard clerk's office near the departure yard.

As the classification tracks fill up, the cars are pushed into the departure yard and made up into trains, which, as soon as they are checked and the air tested, are ready for the road engine to couple on and start, for the bills are usually ready as soon as or before the train is ready.

LITTLE SALMON RIVER VIADUCT.*

By R. F. Uniacke, M. Can. Soc. C. E.

The act of Parliament, authorizing the construction by Commission, of the Eastern Division of the National Transcontinental Railway, provides for a location from its eastern terminus (Moncton) through the central part of the Province of New Brunswick, and through the Province of Quebec by the shortest available route to the city of Quebec. At the time of the inception of the Intercolonial Railway the province of New Brunswick had been thoroughly explored before the final location was adopted, and the controversy of the routes has been fought out over both these great public undertakings. Three routes were located for the Intercolonial Railway, known at that time as the Frontier, the Central, and the Baie des Chaleurs routes, and of these, on the recommendation of the Chief Engineer, and owing to Imperial considerations, since a subsidy aid had been granted by the Home Government, the Baie des Chaleurs route was adopted.

The Engineers of the Transcontinental Railway had located two lines, one known as the River route, following the St. John river, north from Fredericton, and the other the Central route; the latter was adopted as fulfilling more closely the provisions of the act. That a line of railway has now been constructed along this route having a ruling 0.4 compensated grade, with a maximum curvature of six degrees, is owing in a large measure to the advance in modern bridge and high viaduct construction. The valley of the Little Salmon river, 185 miles from Moncton, presented

Fig. 1—General View, Salmon River Viaduct, National Transcontinental Ry.

one of the obstacles to be overcome, as the grade development showed a crossing over 4,000 feet long, with a height of 200 feet above the water line.

The line approaches the west end of the structure with a six degree curve through a rock cut and crosses on a tangent bearing N. 10°—27′ W., the grade rising 0.40 ft. per hundred. The layout consists of twenty-four towers 58′ 9″ centers and twenty-five intermediate spans 100′ 3″ c. to c., the end spans being 100′ 10½″ center of bent to outer end of steel; all the tower spans are alike as are also the intermediate spans, except that the masonry ends are extended to give the required bearing. The towers and bracing are made alike as much as possible, necessitating one set of templates only for the spans and parts of towers which duplicate each other. A through girder system of construction was adopted, the girders being spaced 17′ 6″ c. to c., while the floor beams with gussets were spaced 14 ft. c. to c., along the plate girders. The east end span is on a spiral to a 6 degree curve and in consequence the girders are deflected at this abutment 1′ 3″ off the tangent to the structure, produced. There were several reasons which led to the adoption of a through girder system. In high trestle construction where the use of false-work is out of the question, the most economical layout is that of an intermediate span as long as can be handled with a well designed traveler working from grade, so as to reduce the number of high towers, their pedestals and foundations. Spans of 60 ft. with 40 ft. towers are generally employed, where deck girders are used, spaced 9 ft. c. to c. with bridge ties resting on the top flanges. Owing to the through girder system having a spacing of girders 17′ 6″ c. to c., spans of 100 ft. are handled, since the bearings of the traveler rest on the

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flanges, thus giving that much more base to brace the traveler in handling loads. The stability of the erection outfit is amply provided for so that in this case girders weighing 30 tons were placed in position. It certainly gives a feeling of safety to see from the car window the flanges of a heavy steel girder, and that this is not altogether sentiment is shown by the fact that instances of derailment are recorded, in which the car held to the roadway by the lateral resisting power of these girders.

Substructure.

The approach at the east end being through a rock cut and in order to avoid building the steel work on a curve, and also to utilize the material from the cut without waste, an abutment of reinforced concrete placed on top of the rock fill was decided on. A buried pier built from the original surface at this point would have been over 100 ft. high, difficult to design and build, and very costly. This was avoided by the use of a bank abutment. The concrete was reinforced to prevent danger of cracks from settlement in the bank, and in order to give time for the bank to settle, the ends of the girders were temporarily supported by a cribwork of square timber, before building the permanent abutment.

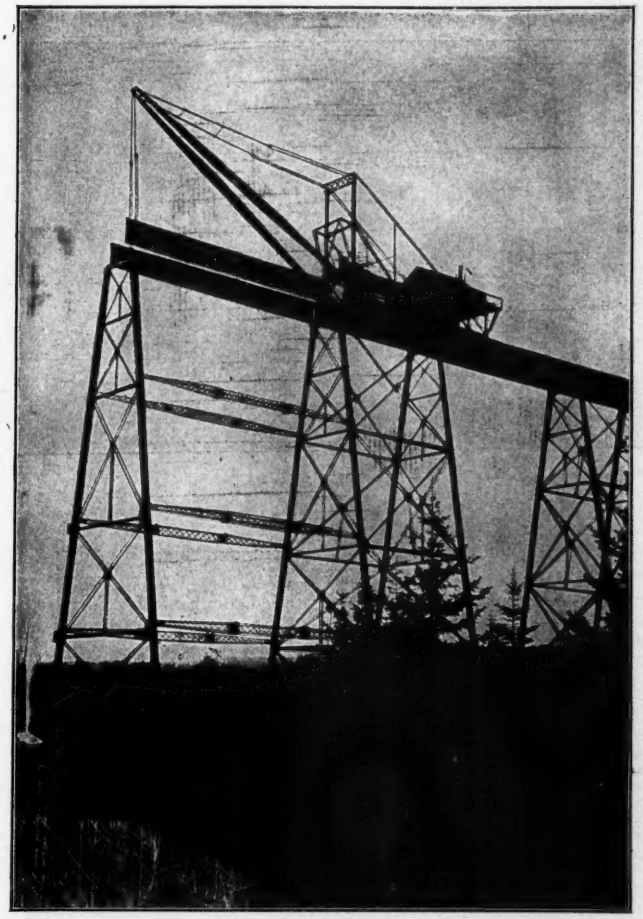


Fig. 3—Placing 100-foot Girder, Erection Struts in Position.

In the design of the pedestals and west abutment, borings and test pits were first made to determine the character of the soil. This proved to be of compact sand, gravel and hard pan, so that no piling was required, the footings being designed to distribute the load at a pressure of from 2.5 to 4 tons per square foot. The four pedestals near the water line at the banks of the river were built with curved cutwaters, the axis of piers being parallel to the direction of the current. The pedestals consisted of two rods, two inches in diameter, the lengths varying according to the up-lift to be resisted. These rods were anchored at the bottom by spacers of 10" channels and washers, the concrete being built around them. In order to give room for a little variation in their position, conical forms were set around each bolt, a lip being left at the top extending beyond the base plate of column through which these voids were filled with grout after the steel was erected. The west abutment or buried pier was about 40 ft. in height above the footing course, and in order to reduce the pressure on the soil and allow the embankment to run through rent, forming suitable icebreakers. The anchor bolts for

— Little Salmon River Viaduct —
Showing Progress of Erection.

Date 1910.	No. of Days	Erected to Date	Tons	Over Per Day	Remarks
To July 30		48	1172		
July 30 To Aug 6	6	47	87½	13½ Tons	
Aug 6 - Aug 12	5	44	355	71 -	
Aug 12 - Aug 18	5	43	60½	12.1 -	
Aug 18 - Aug 19	1	42	128¾	128¾ -	
Aug 19 - Aug 23	3	41	181½	52 -	
Aug 23 - Aug 24	1	40	129¾	129¾ -	
Aug 24 - Aug 26	2	39	107½	511 -	
Aug 26 - Aug 29	2	38	197½	661	
Aug 29 - Sept 16	5	35	436	872	Held up 11 days by broken gear in Plant etc.
Sept 16 - Sept 24	7	33	298½	426	
Sept 24 - Oct 4	8	30	441½	552	
Oct 4 - Oct 11	6	28	351½	585	
Oct 11 - Oct 17	5	27	172½	345	
Oct 17 - Oct 22	5	25	328	656	
Oct 27 - Oct 28	5	23	328½	649	
Oct 28 - Nov 2	4	22	162	405	
Nov. 2 - Nov 5	3	21	157½	51	
Nov. 5 - Nov 12	7	19	320½	459	
Nov 12 - Nov 16	3	18	306½	108	
Nov 16 - Nov 18	1	17	152	152	
Nov 18 - Nov 20	2	16	159	795	
Nov 20 - Nov 23	3	15	152	509	
Nov 23 - Nov 28	4	14	156½	392	
Nov 28 - Dec 2	4	13	150	375	
Dec 2 - Dec 7	5	12	165	99	
Dec 7 - Dec 12	5	11	148	97	
Dec 12 - Dec 16	4	9	311½	78	
Dec 16 - Dec 21	5	8	154	38.5	Struts down for Icebridges
Jan 5-1911 to Jan 11	6	7	167	29½	
Jan 11 - Jan 16	5	6	153	30½	
Jan 16 - Jan 22	5	5	146	29.2	
Jan 22 - Jan 25	3	4	146	48.6	
Jan 25 - Jan 28	3	3	116½	39.5	
Jan 28 - Feb 2	4	2	132½	33	
Feb 2 - Feb 7	5	1	98	20	
Feb 7 - Feb 8	1	End	93½	93½	
	144		7067.5	48.9	- Total Overage Per Day

Chart Showing Progress of Erection of the Little Salmon River Viaduct.

and surround it, an arched void was left in a longitudinal direction. No difficulty was experienced in building to this design.

In laying out the work no triangulation was required and an ordinary steel tape was used, the writer's experience being that, as provision is made in the girders for expansion, a slight variation in the position of the anchor bolts is permissible, providing the expansion slots are made longer than the theoretical length requires. The chief difficulty consists in maintaining the anchors in a vertical position and protecting them from rough usage from swinging buckets of concrete and other equipment.

Concrete.

The materials used in the concrete were International Portland Cement, manufactured by the Canada Cement Co. The sand and gravel were obtained on the bank of the river near the bridge site. In this locality good sand is very difficult

to obtain and, after a test of sand from several pits, the local material was selected, the sieve test showing after the gravel was screened out:

Retained on	20	mesh	sieve.....	64	per cent.
" "	30	"	"	17	" "
" "	50	"	"	15	" "
" "	74	"	"	2	" "
" "	100	"	"	2	" "
				100%	

After treating the finer residue with a 20% solution of sulphuric acid, it was found to contain 6% of soluble matter, which was eliminated by thorough washing, and a mixture of one part cement, two parts sand, and four parts of gravel, varying from the size of a pea to 3 inches was obtained. As the sand was not of the best quality, the use of 1-2-4 mixture was ordered in shafts of pedestals, since they have to sustain a high concentrated load on a comparatively small volume of concrete. The concrete used in the buried pier and foundations was a 1-3-5 mixture. In obtaining a proper facing mixture the coarser material was kept away from the forms by the use of perforated spades, pushed down and drawn back while the mixture was still plastic. This method was found more satisfactory than that of attempting to bond a facing mixture into the body as required in some specifications.

Cement.

The following description of the method adopted for sampling and testing the cement used on all structures under construction on the Transcontinental Railway may be of interest.

The cement specifications are standard and the governing tests are for fineness, specific gravity, soundness, time of setting, and tensile strength. The cement must not acquire its initial set in less than 45 minutes and must have acquired its final set within 10 hours, the briquettes being kept in a damp closet for 24 hours and afterwards immersed in water until time of breaking.

Sampling.

It is the writer's practice on receiving notice that a consignment of cement is to be shipped to a contractor to send an inspector to the mills to draw samples from the bags as they are being loaded into the cars; one bag in forty is sampled, both doors of the car sealed with the N. T. R. lead seal and the sample cases forwarded to the cement testing laboratory in Ottawa, in charge of a chief cement inspector in the bridge engineer's office. The seal being intact on arriving at the bridge site is a notice to the field inspector that the car has been sampled by the bridge department. The preliminary tests for soundness are made at once and the mills are notified to hold the cars if these results appear doubtful. The final record covering the full 28 days tests is generally completed and the contractor advised of the acceptance soon after the cars are on the work. In mills where the records have been continuously good, the contractor has been permitted to use the cement on completion of the seven days' test, in some cases where work would be held up for want of cars, but always at the contractor's risk and subject to conclusions obtained from the twenty-eight days' tests; in no case where this has been allowed has the result proved a mistake in judgment. A cement sampling record slip is enclosed in the sealed sample case giving all information as to shipment. Copies of the final test record are furnished to the district engineer as well as to the mills for comparison with the manufacturer's tests, and the records are compiled in loose leaf books for future reference. By means of these records, and a system of reports from the field inspectors of the arrival of cars, it is an easy matter to trace any car and identify its contents after being piled in the cement storage house at the bridge site.

Design.

The Dominion Government specifications were strictly adhered to in the proportioning of the members. The compression members were figured for the pin ended formula of these specifications. In the tension members of the towers a limiting length of $200 - \frac{l}{r}$ was used to avoid sagging of members, to make them capable of resisting compression and to give initial stiffness. Attention is called to the use of bulb angles in the sway bracing of towers, which make a very stiff and economical section and avoid breakages in shipment, the great fault in box laced sections of light angles. Traction and wind were figures as called for in the specifications.

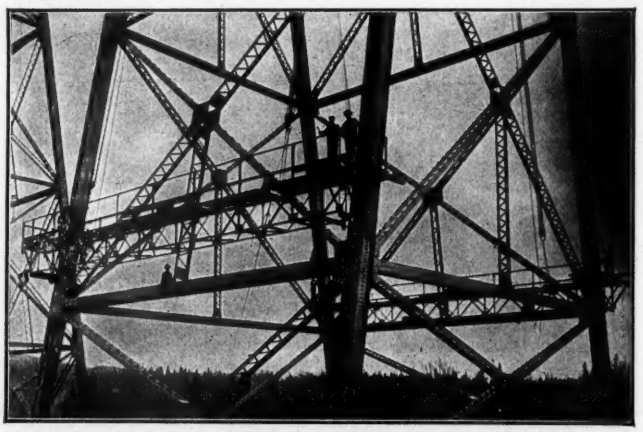


Fig. 4—Riveting Galleries.

The posts viewed from the stress sheets do not appear to be economical because of their relatively small radius of gyration when compared with a built up channel section; but the saving in weight of details and simplicity in shop work fully compensates for the extra main material. In the light of column tests it is reasonable to expect that the reduction in unit stresses for the increase of radii length would not be justified by practical tests. The metal is used mostly in directly resisting the primary stresses, as very little is required for secondary purposes (viz., lattice tie plates, etc.), and in this way a stronger column is obtained. The section used has also the advantage of continuous webs in each direction, which are greatly superior to the easily bent lattice bars, and moreover the interior of the column is much more accessible to the paint brush for shop and field coats. The section is symmetrical on both axes, having therefore its center of gravity in the center of the section, and no eccentric loading is induced from the girders. The small amount of redundant metal means uniformity of stress in the columns, and simplicity in the make up will decrease the cost of maintenance.

Tenders.

In calling for tenders for the steel work our usual practice was followed, furnishing bridge companies with a general design and details of girders and towers together with a printed form of tender in which was filled-in the estimated weights of steel, and number of feet B. M. of timber in the floor. With this system all bridge companies bid on the same basis, and are not required to make a single drawing to submit with tenders, but merely to fill in the unit prices

for steel and timber erected in place, and to carry out the amounts on the estimated quantities furnished, viz., steel 14,000,000 lbs., timber 520,300 ft. B. M. After the tender is awarded the bridge company submits stress sheets and details for approval before ordering the material from the mills.

Floor.

The rails were directly supported by 8" x 12" x14' bridge ties resting on the steel stringers, every fourth tie being 16 ft. long to support the plank footway placed outside the guard timber for the convenience and safety of the section men. An outside guard timber 8" x 9" dapped 1" over the ties, which were spaced four inches apart in the clear; the ties were secured to the stringers by ¾" hook bolts, and the guard timbers bolted through the tie with one ¾" bolt in every fourth tie. A steel guard rail 60 lbs. to the yard will be placed inside the gauge line, and eight inches therefrom in the clear, these guard rails coming together at the center of the track one rail length beyond the end of the bridge and being protected by a cast steel point fitting the rail section and spiked to the road-bed ties.

Fig. 5—Moving the Riveting Galleries.

Erection.

Actual erection began July 27, 1910; the steel was all assembled and last span swung February 8, 1911, and all riveting and painting fully completed by August 19, 1911. Material was unloaded at a siding at the west end and handled by a two boom derrick car in the storing yard. A light, standard gauge locomotive with lorry cars handled the material from the storage yard to end of steel. The main feature of the erection outfit was the 30 ton two boom erection derrick, traveling on the top flanges of the girders, the trucks of the traveler running on 115 lb. crane rail, the base of which rested on timber temporarily secured to the girder flanges. This derrick was self-propelling by means of a chain and sprocket connecting the trucks with the erecting engine, which consisted of two 10" x 12" cylinders—two drum 4 spool hoist. The 115' 0" booms were box sections composed of 4—36" x ¼" web plates at center section and tapering at the end, connected with four—3½ x 3½ x ⅜ angles. This section was found to weigh actually less than a latticed section and the combined unit stresses from compression and bending were very much reduced. The writer was told that the men working on the traveler, and assembling, were very enthusiastic over the ease with which the big machine handled its work. The wind at the deck of the trestle was very strong, and was generally blowing at right angles to the bridge, but the work was practically never held up on account of too much wind. The use of the erection struts is shown in the photograph, Fig. 2. After a tower and its girders were assembled the erection struts were removed and used again to stiffen the first bent of the next tower until it too was connected and self sustaining. The hook bolts temporarily connecting the ends of three struts with the columns proved very efficient.

Another important feature was the use of riveting bridges for convenience and safety of the men in assembling, riveting and painting. From the photographs, Figs. 4, 5 and 6, the method of handling them will be plainly seen. They were carried along the top of the trestle by the two boom yard derrick car, and after being secured to the top flanges of girders by hooks, the cages were lowered or raised by hand, as required, the free end of the tackles being on the platform, so that the riveters could slack away themselves.

The erection staff varied from 60 to 80 men, of which but 6 were employed on the big traveler; 1 sub-foreman and 14 men were used to assemble the steel work, and the rest formed from two to six gangs of riveters and the crew for derrick car used for unloading material in yard and delivering same to traveler, and a driver for the light locomotive. The riveting gangs averaged 302 rivets per day of 10 hours per gang, a rate which would probably have been reduced by 50% if ordinary staging had been used, instead of the riveting cages.

The table showing progress of erection indicates rather remarkable time, considering the force employed. A pair of 100 ft. girders have been swung and bolted in their final position in 37 minutes, and floor beams and stringers assembled in half a day.

Painting.

One coat of Sherwin-Williams black metalastic paint was used in the shop, with a coat on each contact surface before assembling. Two field coats were applied, the first Metalastic brown, and the final coat acheson graphite. Rivet heads and shop marks were touched up before applying the field coats. The use of a different shade for the first coat was a great help to the inspector, to enable him to see that the several coverings were properly applied.

Inspection.

The inspection of this work covers mill, shop, and erection inspection, all in accordance with the Dominion Government specifications of 1908. The bridge company, on being advised of the name of the inspection company, which it to do the inspection, is required to furnish them in triplicate with copies of all mill orders; one copy is sent to the inspection com-

pany's representative at the mills where the material is to be rolled.

The inspector then makes arrangements to be present at the rolling of the material which is being furnished on these orders, making complete surface inspection of every piece, measuring it for width and for length, and gauging the thickness. Specimens are then selected from the material so inspected by the representative of the inspection company, taken from each heat of steel which has been rolled into the material furnished on his particular order. These test pieces so selected are then forwarded to the machine shop to be properly prepared, that is to say, machined on both edges and straightened true. The test pieces so prepared are then

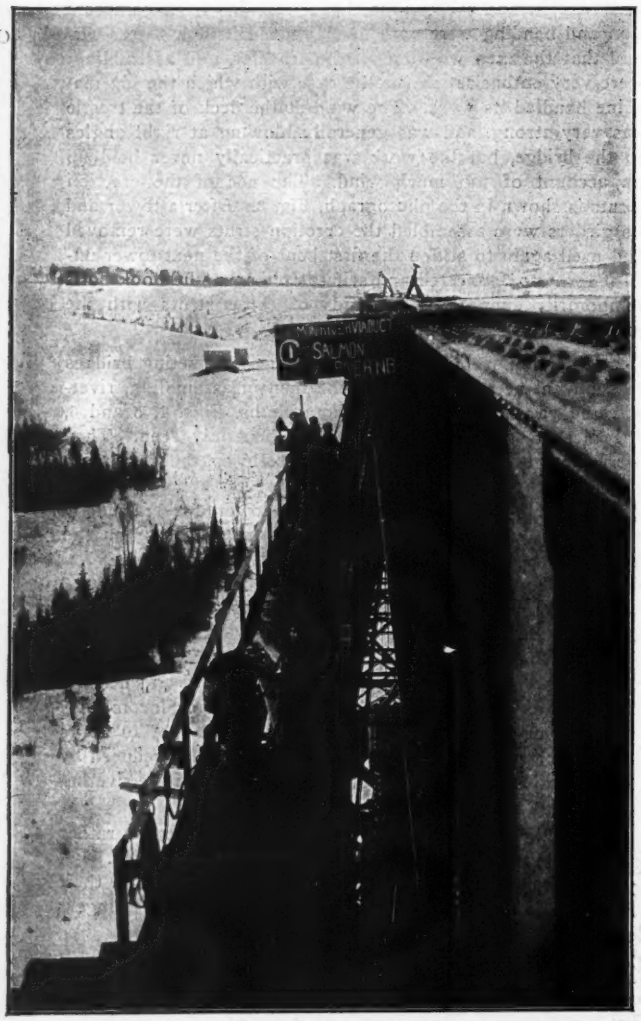


Fig. 6—Riveting Galleries in Position at Top of Tower.

sent to the testing laboratory at the mills, where the same are measured and broken in the testing machine, in the presence of the inspector. The results from this test piece have to conform with the requirements of the specifications, that is to say, the tensile strength has to be within the limits, as have also the elongation and reduction of area of the steel. The inspection company, in addition to witnessing the pulling of these test pieces previously selected by their representative, also secures from the rolling mills a certificate of the chemical analysis of the steel tested. Frequently the inspector requires drillings to be taken from the test pieces at the mills, so as to check up the accuracy of the reports presented to him by the rolling mill company. Test pieces and material which they represent are identified by melt numbers.

As soon as surface inspection of the material has been made, and the tests have proven satisfactory, the inspector then undertakes to see that the material is properly loaded in the cars ready for shipment to the bridge works. Full descriptive reports are then made out by the inspection company, showing the number of pieces and the size and length of each piece so shipped from the steel works, together with the results of tests. These reports are then sent forward to the bridge engineer.

Shop Inspection.

As soon as the material has been received at the bridge works, the same is then unloaded, and when work is ready to be commenced, the various pieces of material which go to make up a full sized member are brought into the shop. The representative of the inspection company is present to see the laying off of the material, the first step in the prepar-

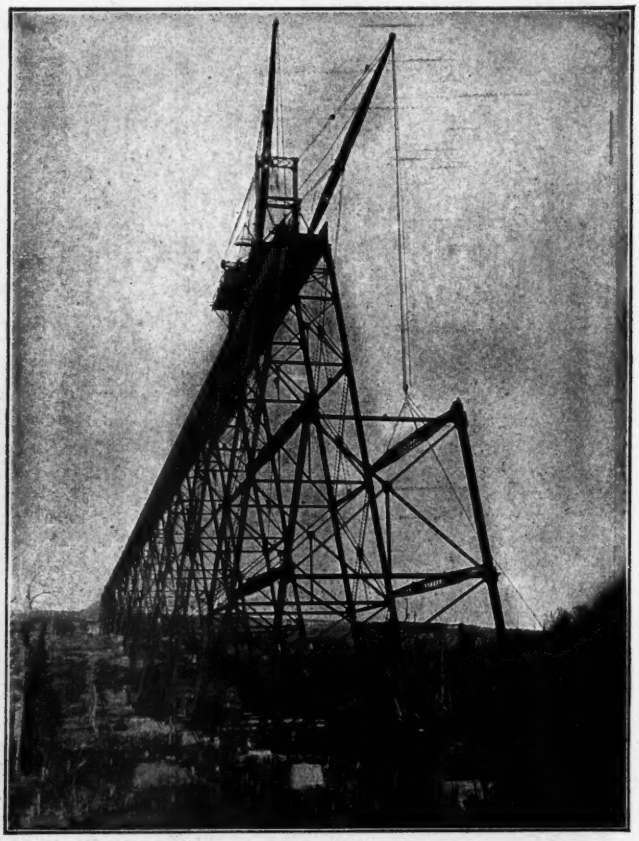


Fig. 7—Erecting the Supports.

ation for punching. The punching is then witnessed by the inspector to see that punches and dies of correct size are used, as required by the Dominion Government specifications. The inspector then further sees that the material, as soon as it is punched, is properly assembled, and that a sufficient number of bolts are used, so as to insure perfect fit and matching of all holes, prior to the same being riveted. The process of riveting is also supervised; and, lastly, the finished member is checked over to see that the measurements and clearances are correct, and that construction is in full accordance with the shop drawings submitted by the bridge company and approved by the bridge engineer.

The painting, which is also a very important part of the work, is then closely supervised, to see that the temperature in which the material is painted is suitable for such painting, also that the material so painted is stored under cover until such paint has become thoroughly dry.

After all these several stages of construction have been witnessed, and also the final checking up of the material, full detail reports are then made out showing what material has been constructed during the week, also what other material is under course of construction, and what material has been shipped, also commenting on any errors that have been discovered and how the same have been remedied, with a report in addition as to what future progress would be expected.

Inasmuch as the material has been purchased on a pound price, the inspection company has special representatives at

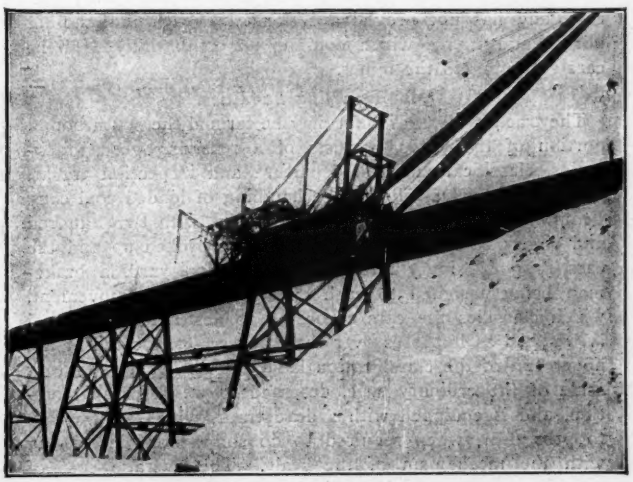


Fig. 8—Placing Last Girder.

each of the bridge plants estimating the weights of all materials entering into the various members, so as to check up against the actual weights furnished by the bridge company. If the actual weights are in excess of 2 per cent, as allowed by the Dominion Government specifications, such weight is cut down to the estimated weight, made up by the inspection company, based on an allowance of 2 per cent.

Inspection of Erection.

As soon as the bridge companies have made shipment of their first car-load of material, and the erection gang of the bridge company has arrived at the bridge site, on the order of the bridge engineer, an inspector is immediately despatched by the inspection company to such site. He supervises the erection of the entire structure from start to finish, seeing that the same is carried out in strict accordance with the requirements of the specifications. As the work progresses, the inspector takes at least three photographs each week, showing the progress that has been made, and also keeps an account of the labor expended in connection with the erection of the particular bridge on which he is engaged. To show that the photographs are taken weekly, a special sign is furnished by the inspection company, on which the name of the structure appears together with the date on which the photograph was taken. This is given a conspicuous place in the photograph. Weekly reports are furnished by the inspector, and the bridge engineer is kept advised as to all movement or delays that might occur at the erection site in connection with such structure. On completion of the bridge, the inspection company then reports that the work has been carried on to the satisfaction of its inspector, and such report is forwarded to the bridge engineer, who, himself, or through his representative, makes final inspection of such bridge structure, after which payments for the completed work are made. In all the various departments of inspection at the mills, at the bridge shops, and on erection, only men who have had long experience and training in that particular class of work are engaged.

Throughout all the various courses of construction a private stamp is used, bearing the trade-mark of the inspection company, together with a number representing the inspector who has used this particular stamp. This serves as a means of identification, so that the inspector at the shop, and also at the field may see that the material has been inspected and accepted. By this means if any faulty or defective workmanship should show itself, the inspector who passed this particular piece of work can be easily located by the number which he carried affixed to his stamp.

Costs and Estimates.

In the final estimates the actual amounts and cost under the several items are:

Substructure:

1,757	cu. yds.	1-2-4 Concrete	@	$15.00
6,524	"	1-3-5 "	@	11.00
4,597	"	Excavation	@	1.00
10,534	"	"	@	2.50

Superstructure:

Steel	13,991,310 lbs	@ 4.68 cts.	=$654,793.31
Timber	518,041 ft. B. M.	@ 4.60 cts.	= 23,829.89
			$678,623.20

Progress estimates were paid monthly on the superstructure according to the following basis:

	Unit.	Rate.
Steel	100 lbs.	$ 4.68
Timber in floor	M.B.M.	46.00

Schedule for monthly estimates.

	Unit.	Rate.
Steel provided	100 lbs.	$2.00
manufactured	"	1.00
delivered at site	"	.40
assembled	"	.98
riveted	"	.15
painted and fully completed	"	.15
		$4.68
Timber delivered	M.B.M.	$40.00
framed and placed	"	6.00
		$46.00

This basis of payment was considered a fair and equitable distribution of cost throughout the different stages of manufacture. It is the result of experience on many bridges previously built by this and other bridge companies on the described method of working and specifications, and the writer believes may fairly be used in other similar cases, as proportionate cost data.

The work was carried out under the general direction of the writer from the bridge engineer's office in Ottawa, Mr. W. A. Duff, assistant bridge engineer, having charge of the general design and details. The Dominion Bridge Co.,

Limited, Montreal, had the contract for the steel, which was efficiently carried out, Mr. F. P. Shearwood, C.E., having charge of the design for the bridge company.

The design and layout for the erection and the traveler were made under the direction of Mr. James Finley, superintendent of erection, who was responsible for the successful carrying out of the erection; also Mr. E. W. Nichols, foreman on erection. The mill, shop, and erection inspection was satisfactorily carried out by the Canadian Inspection Co., Limited, Montreal.

The sub-structure was completed by Messrs. Powers & Brewer, sub-contractors under Willard Kitchen Co. The construction and laying out of this part of the work was performed under the direction of Mr. C. O. Foss, district engineer. Although the work was prosecuted in all seasons of the year there has been no accident or casualty of any kind.

It is expected that the Denver & Rio Grande will shortly place contracts for a considerable amount of betterment work. This work includes double tracks between Castle Gate and Kyune, and between Tucker and Thistle, a distance of 20 miles.

The Colorado & Southern is to carry on improvements on the line from Orin Junction, Wyo., which includes replacing 56-lb. rail with 85-lb. rail on 35 miles and constructing a four-stall temporary engine house and a 50-ton coal chute at Hartville Junction.

The Georgia Coast & Peidmont has started work on the extension of its line from Darien to Brunswick, Ga. The work was started from Darien, Ga., and considerable headway has been made in clearing the right of way leading from the McIntosh county seat to the Altamaha river, where the road will cross a trestle and enter Glynn county.

The Georgia Roads are making plans, it is said, to build from Macon, Ga., west of Waverly Hall, about 70 miles. The Macon Chamber of Commerce and S. W. Hatcher are interested.

The Huntington, Richmond & Hamilton has been incorporated in Indiana with $100,000 capital to build from Huntington, Ind., to Richmond, 98 miles. The directors are S. H. Bracey, L. Brandenburg, F. A. Dolph and F. Bimmel.

The Iron County Central has been incorporated in Missouri, with $60,000 capital, to build a six-mile line from Bixby, Mo., to Timberlands. The incorporators are L. T. Carroll, D. A. Bixby and A. B. Brigham, St. Louis, Mo.

The Kansas City, Mexico & Orient will, in a few days, let the contract for constructing the extension from Granada to Fort Stockton, Tex., 32 miles.

Work is well under way by construction forces of the Missouri Pacific-Iron Mountain system on the completion of the double track from Texarkana, Ark., to Hoxie. It is hoped to have the new line in operation by October.

The Quanah, Seymour, Dublin & Rockport has let a contract to E. Cowperthwaite and associates, of London, England, to finance and build this line from Rockport, Tex., on the gulf coast, to Belton. This work is to be finished within two years, and the section from Belton to Quanah, near the Oklahoma state line, is to be finished within three years. L. E. Walker, president, Austin; R. Y. Walker, chief engineer, Belton.

The White Sulphur & Huntersville of White Sulphur, W. Va., has been incorporated with a capital stock of $30,000 and proposes to construct a railroad from White Sulphur, Greenbrier county, to Huntersville, Pocahontas county. The incorporators are Frank A. Hauck, of Ronceverte, W. Va.; Frank Hoen, Joseph T. England, William R. Hudgins and Warren B. Bunting, of Baltimore, Md.

COAL YARDS OF THE PHILADELPHIA AND READING RY. CO. AT ST. CLAIR, PA.

By P. S. Lewis.

An important extension of facilities for the handling of coal traffic is being made by the Philadelphia and Reading Railway Company in the construction of fully equipped yards for the weighing, classification and making up of coal trains at the western terminus of the Reading division between the towns of St. Clair and Port Carbon, Schuylkill county, Pa. The topography at this point is peculiarly adapted to the location of such a yard. The tracks cover the area of a flat valley about two miles long and one thousand feet wide, through which, and without the use of a prohibitive amount of embankment or excavation, it has been possible to maintain approximately a 1.2 per cent grade, from the lower to the upper end of the yard, so that all south bound, or loaded cars or trains, are shifted entirely by gravity. This natural grade has eliminated the necessity of a hump for the classification of the loaded coal cars, and has not proved a serious drawback in handling northbound traffic, which consists almost entirely of light cars returning to the mines.

Coal Handling Facilities.

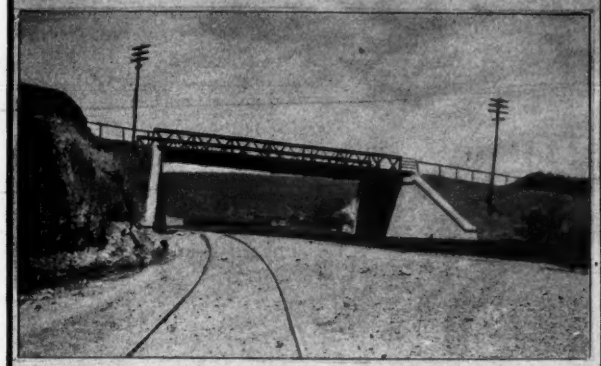
The track system, of what may be termed the south bound portion of the yards, consists of a receiving yard, track-scales, classification yard, departure and inspection tracks, and is used exclusively for the handling of loaded coal cars. From the receiving yard of eight tracks, with two hundred and eighty cars capacity, the trains are broken up and the cars dropped singly into the classification yard, a brakeman being assigned to each car. During this movement, which classifies the cars according to destination, the coal is weighed as it passes over the track scales, located at the upper end of the classification ladders. This is a sixty foot scale of the ordinary type, designed to weigh cars in motion, and is equipped with a dead track, which allows cars to pass over, when required to do so, without interfering with the mechanism of the scale. The average cost of handling a car over the scale is fourteen cents, and it has been found possible, in a twelve-hour shift, to weigh 1,512 cars, or an average of 126 cars per hour, in the consideration of which it should be remembered that in this movement cars are dropped singly.

An idea of the working capacity of, and volume of traffic handled by, the south bound portion of the yards, may be gained by an observation of the table below, showing the number of cars and tonnage of coal which passed over the scales during January, February and March of the current year, together with the number of shifts worked and the number of main line trains in which these cars were sent from the departure yard:

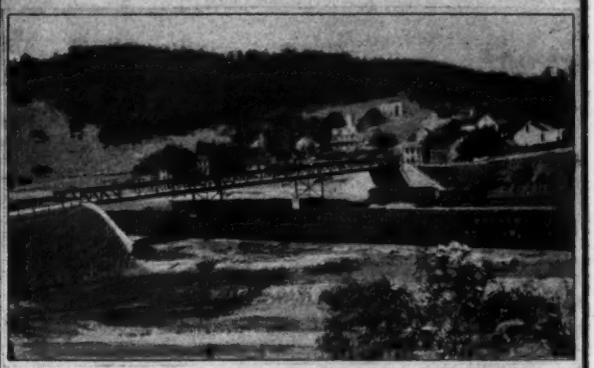
	No. of Cars.	Tons of Coal.	No. of Shifts.	Av. No. of Cars per hour.	No. of Trains
January	26,432	778,087	28	78	411
February	29,177	784,548	28	86	448
March	33,129	935,284	30	92	504

The three switches controlling the base line tracks of the classification yard are operated from a single point at the scale office, the ladder switches being turned by hand. It is proposed to abandon this method later on, in favor of an electric switch system with interlocking devices, which will operate all the 35 switches from the one point.

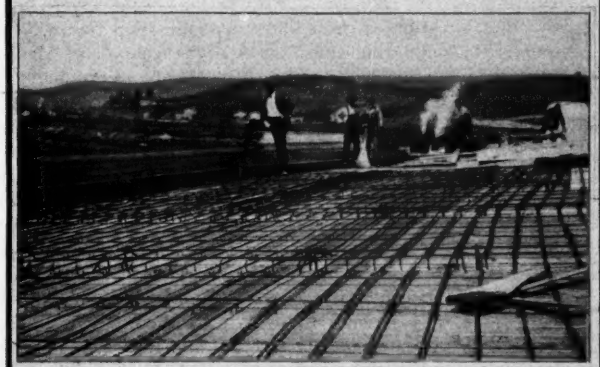
From the classification yard of 35 tracks and 1,525 car capacity, the cars are dropped in drafts of 10 to 65 and are assembled in trains on the inspection tracks of the departure yards. These 9 tracks, spaced 15-foot centers, and piped throughout with air at 110 pounds, have a capacity of 75 cars each with engine and caboose. Before leaving this yard the trains undergo a thorough inspection and are put in perfect condition for main line movement. All air-



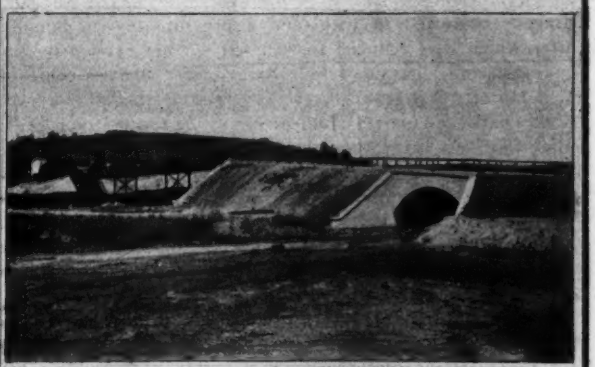
OVERHEAD BRIDGE AT RUSSELL STREET.



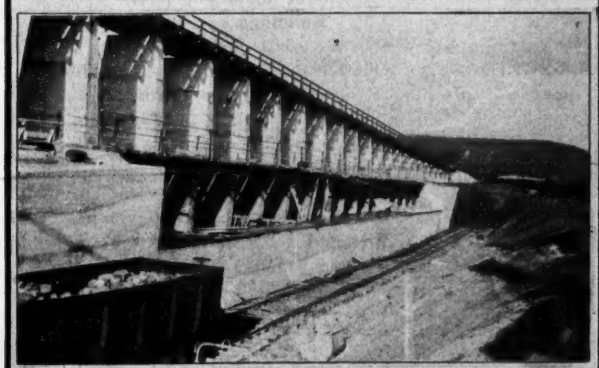
OVERHEAD BRIDGE AT DORMERS.



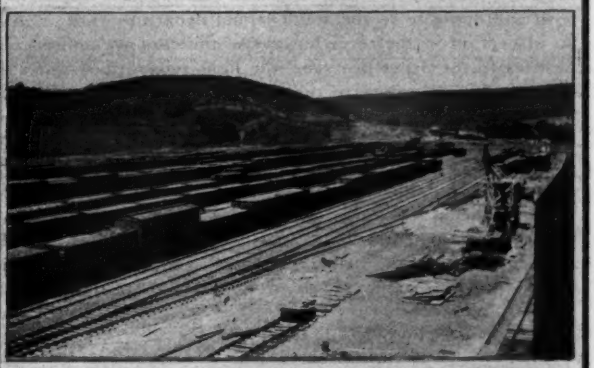
REINFORCEMENT OF ROUNDHOUSE ROOF SLABS, ST CLAIR ROUNDHOUSE.



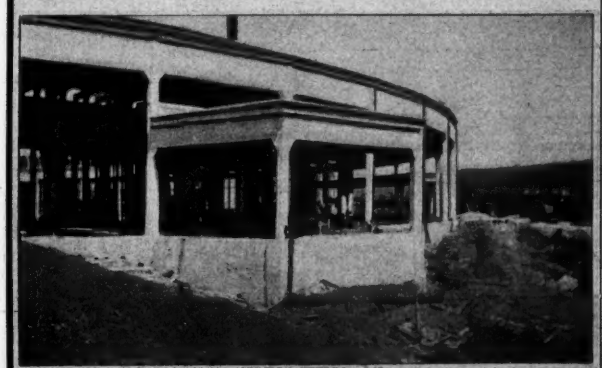
NORTH APPROACH TO DORMERS BRIDGE AND ARCH OVER MILL CREEK.



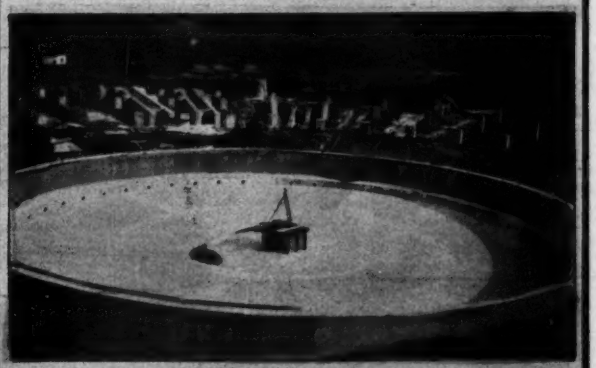
PART OF COALING STATION AND NORTH BOUND ASHPIT.



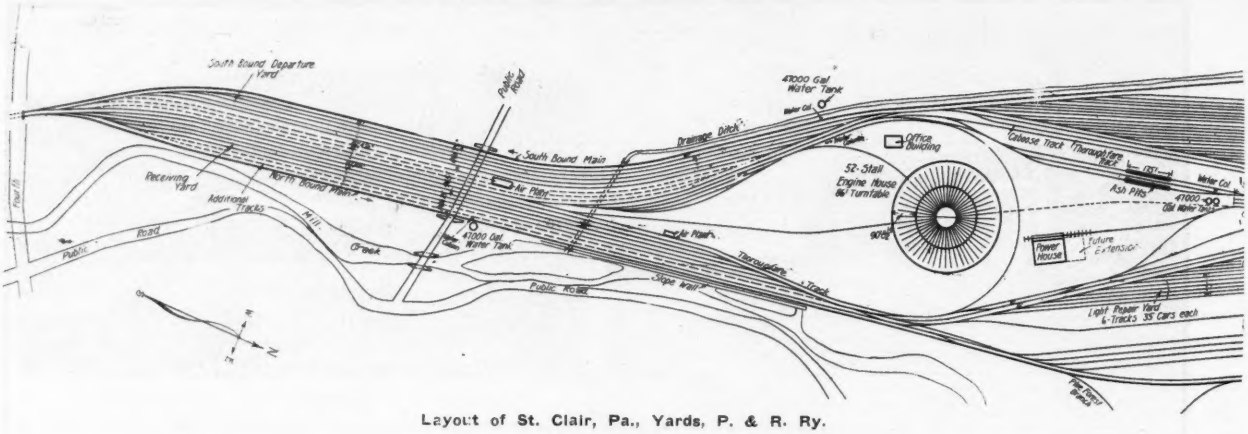
PORTION OF SOUTH BOUND CLASSIFICATION YARD.



EXTERIOR WALL OF ROUNDHOUSE AND FAN HOUSE.



TURNTABLE PIT, ST. CLAIR ROUNDHOUSE.



Layout of St. Clair, Pa., Yards, P. & R. Ry.

brakes are tested to withstand a pressure of 110 pounds, after which it is reduced to 90 pounds (that carried by the engines), and all trains leave charged with 100 per cent air. In addition to airbrake inspection and repairs, all journals, brake bars and safety appliances are inspected and such minor repairs made as may be found necessary. During March, 1912, there were 27,134 cars inspected and sent away in 504 main line trains. Of this number 6,989 were foreign cars. In addition to the many minor repairs to journals, safety appliances, brake bars, etc., others made during March were: 750 triple valves and cylinders cleaned, and 1,146 air brakes repaired.

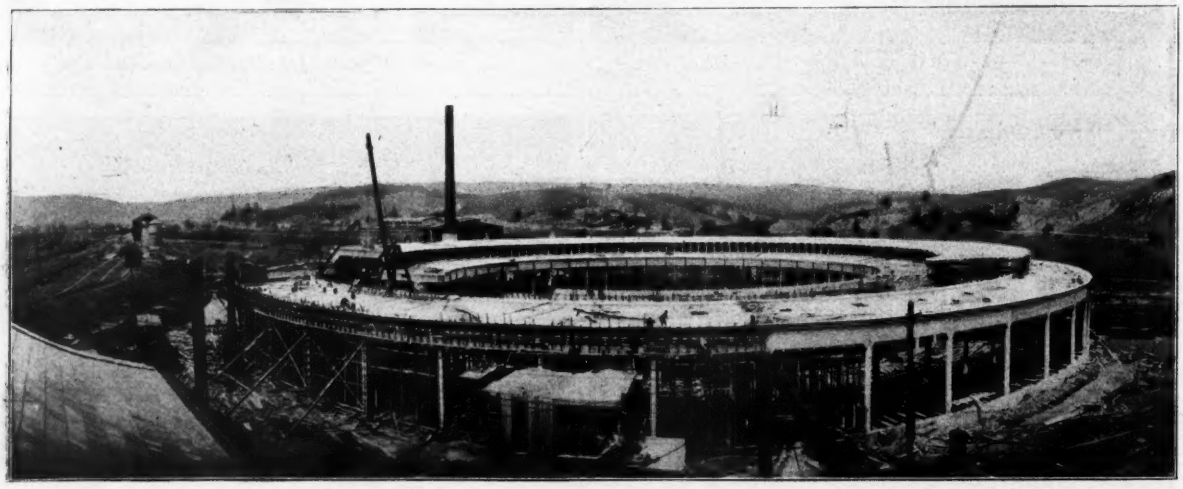
Light Traffic Handling Facilities.

The north bound portion of the yard provides facilities for the receiving and repairing of empty cars and for the making up of trains for their return to the collieries. The receiving yard of 9 tracks and 585 car capacity is parallel with and opposite to the south bound departure yard. After an inspection in the receiving yards, the cars are shifted by pushers to the departure yard, the light repair tracks, or the shop tracks, according to the repairs found necessary. The departure yard and light repair yard, which is also used as a departure yard, have 6 tracks each and a total capacity of 420 cars. Construction of the proposed repair shops has not yet been commenced, but it is the intention to start this work in the near future. They are to provide, in addition to other equipment, two cranes for the lifting of empty cars and one for the lifting of loaded coal cars which may be in need of repairs. The north bound track system has, with the exception of these shops and the shop tracks, been completed, and during the months of February and March, 18,710 and 21,086 empty cars, respectively, were handled over it. Between the north bound departure and south bound receiving yards there are four tracks for the storage of engines, with a total capacity of 35 engines. A caboose track at the upper end of the south bound departure yard is so located that cars may be placed on, and removed from it, in order of their arrival, the cabooses being dropped by gravity to the rear of the departing trains. There is a loop track around the engine house from the north bound receiving to the south bound departure yard, allowing a quick movement of engines between these yards without the necessity of going on the turntable. The north and south bound main tracks separate at either end of the yard and run outside of all yard tracks, reducing to a minimum the number of frogs and switches required on the main line tracks.

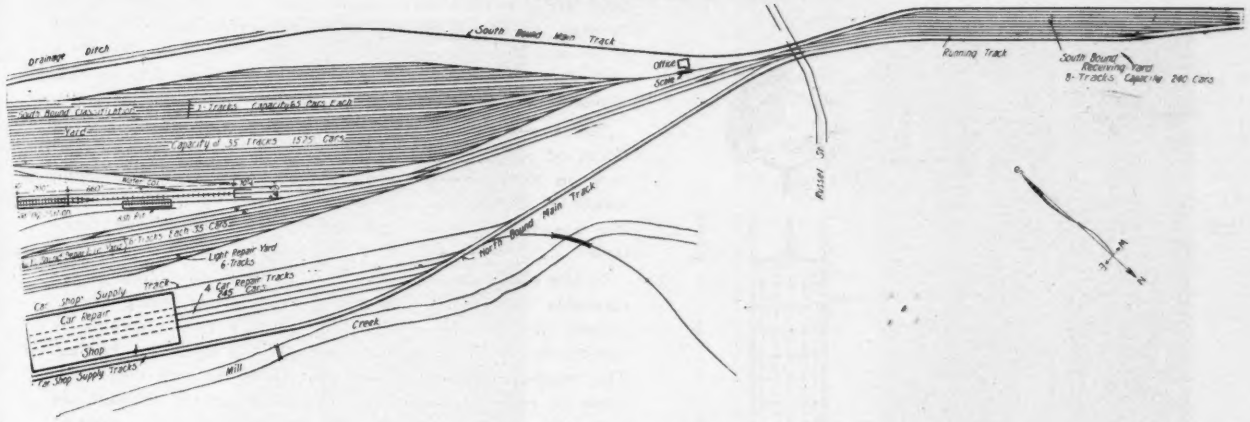
Buildings.

At the upper end of the south bound departure yards the north and south bound track systems separate, forming a wye and affording a site for the new engine house, power house, office building, coaling station and ash pits. There is no transfer or freight station, as provision is made in these yards for the handling of coal only.

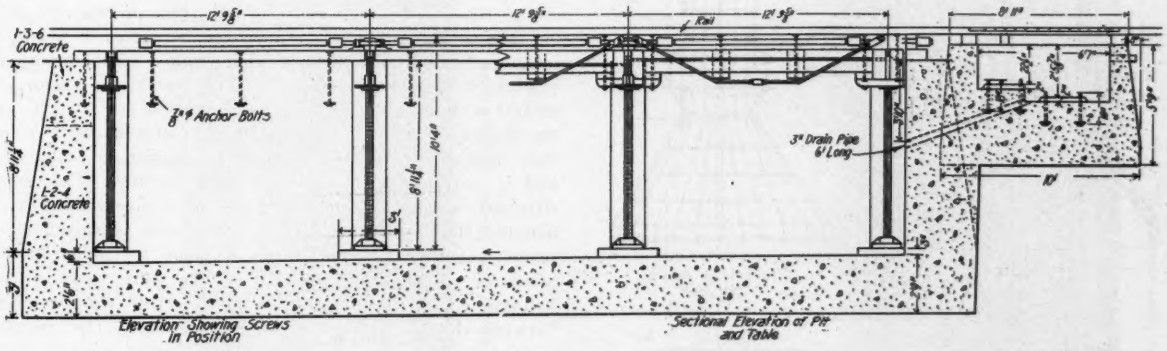
The engine house, which is nearing completion, is a circular structure of reinforced concrete; inner radius 107′ 8½″ outer radius 198′ 4⅜″, making width of building 90′ 8½″ between columns. There are in all 52 bays, the angle between tracks being 6° 55′ 23″. Thirty-three of these



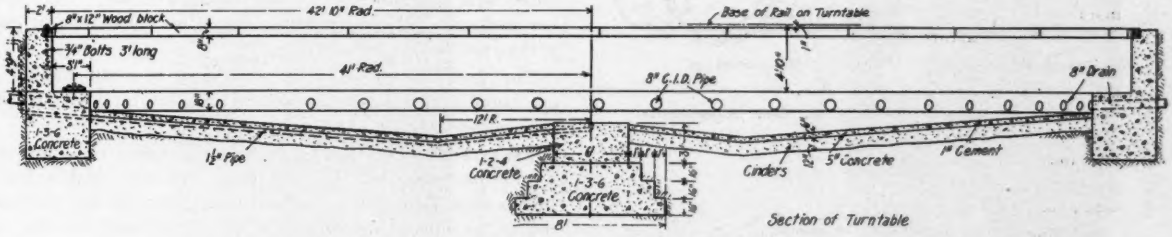
St. Clair Roundhouse, P. & R. Ry.



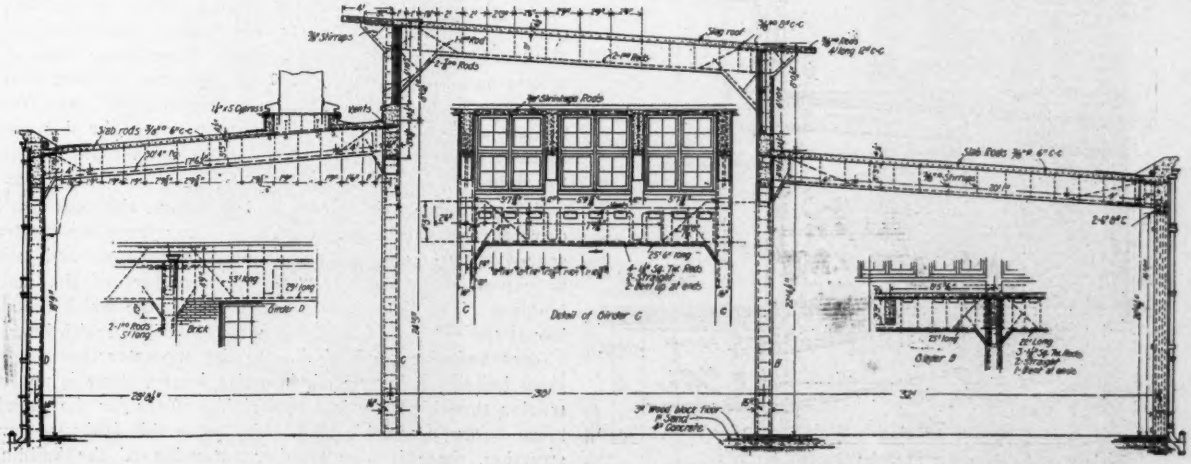
Continuation from Opposite Page.



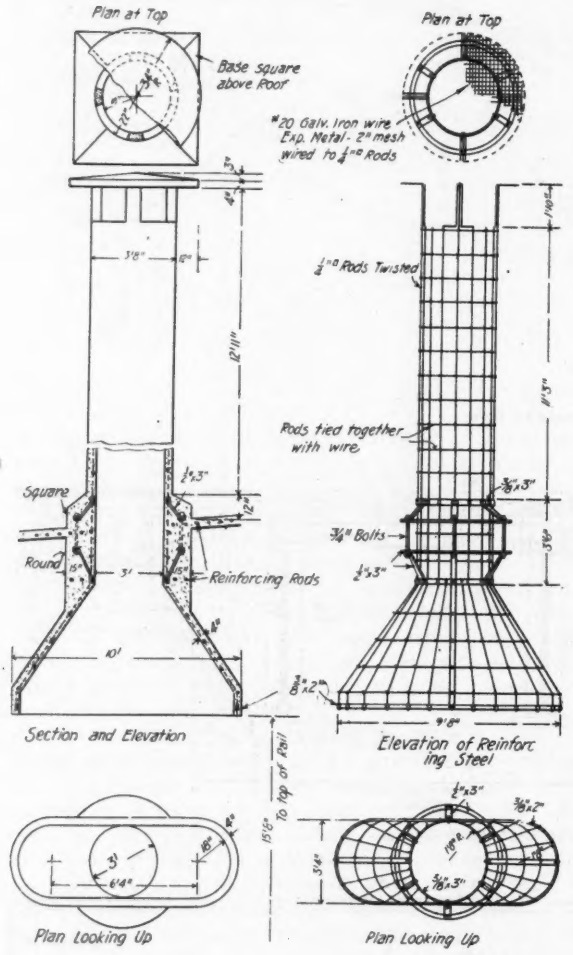
Section Through Drop Pit, St. Clair Roundhouse.



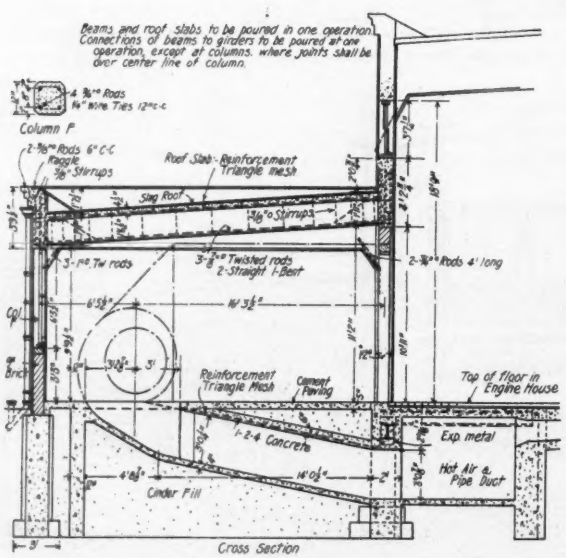
Section Through Turntable Pit.



Section and Details of St. Clair Roundhouse.



Details of Concrete Smoke Jack, St. Clair Roundhouse.


Beams and roof slabs to be poured in one operation. Connections of beams to girders to be poured at one operation, except at columns, where joints shall be over center line of column.
Column P
Roof Slab - Reinforcement Triangle mesh
Slag Roof
Reinforcement Triangle Mesh
Cement Paving
Top of floor in Engine House
Exp. metal
Hot Air & Pipe Duct
Cinder Fill
Cross Section

Section Through Fan House.

bays are provided with engine pits, two are taken up as passage ways, and the remaining seventeen are to be used at present for a machine shop. However, their design is such that they may be converted into engine pits as the demand may arise.

The engine pits are 65 feet long, with walls and convexed floors of concrete; the rails, which are tie-plated, are carried on 8x12-inch creosoted yellow pine stringers. The length of stall along the centre line is 90 feet, the locomotive standing normal with the tender towards the turntable.

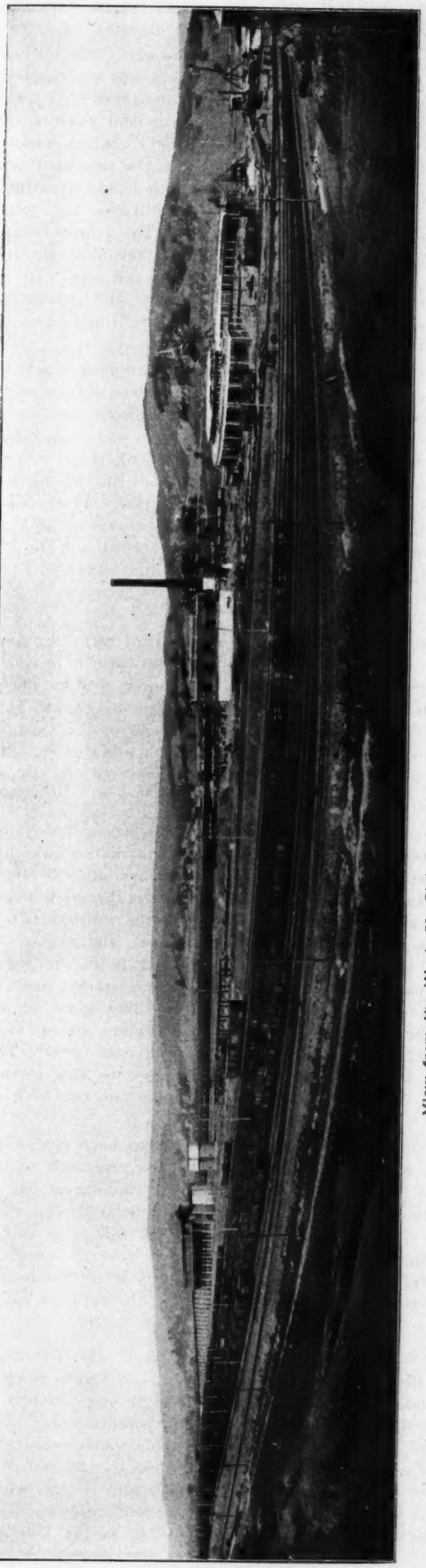
In the centre of the house there is an 85-foot deck girder turntable operated by electricity, the power being transmitted through the pivot. The pit for this turntable is constructed of concrete with an 8x12 inch white oak coping. The engine pit drainage and that from the two inner sections of roof discharge into the turntable pit through an eight-inch pipe at each bay, the turntable pit being drained in turn by a 24-inch pipe to the general drainage system of the yard.

The superstructure consists of a system of concrete girders, beams and roof slabs, supported by series of four columns each, on radial lines between stalls. The columns are reinforced with longitudinal bars and hoops; the beams and girders with a combination of the horizontal bar, stirrup, and the bent-up bar. The roof slab is reinforced with round bars running in two directions perpendicular to each other, and is covered with a four-ply slag roofing. The superstructure is built in three sections, the centre section overhanging the inner and outer sections and is raised about seven feet above them, affording space for large lantern windows which are 8' 10"x5' 8". The outer wall of the building is of red brick with a 15' 10"x15' 6" window frame between the concrete columns of each bay. The entrance doors, which swing inward, have a 4' 5"x8' 5" window frame in the upper part of each door, and every third bay is provided with a small door within the larger one. The number and size of these windows assures an abundance of light within the building.

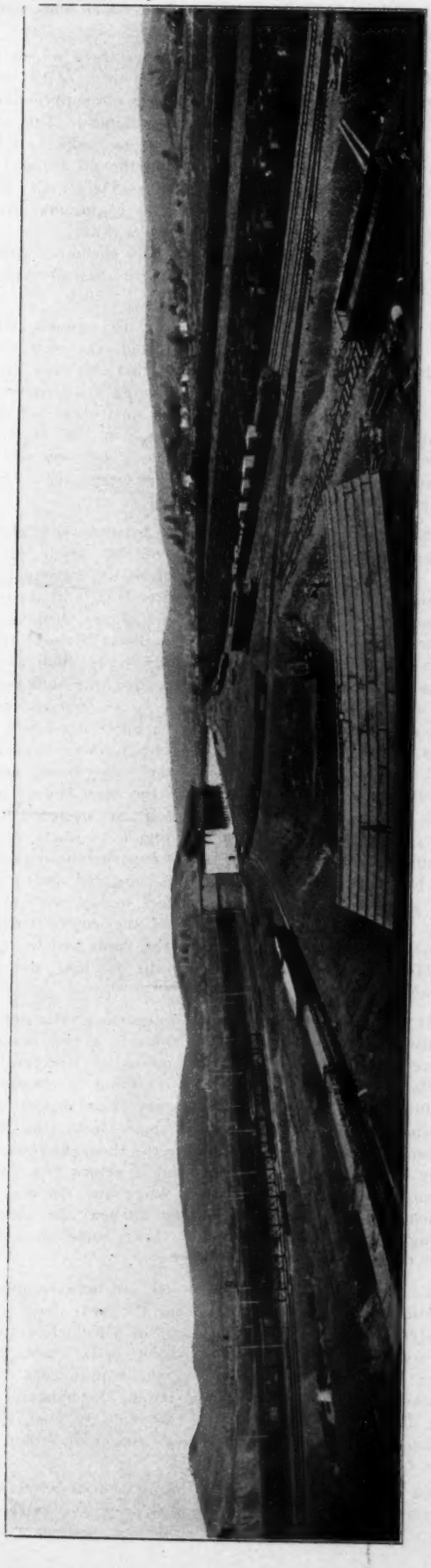
The floor in the machine shop and between pits is of creosoted long leaf yellow pine blocks laid on a 4" concrete foundation and 1" sand cushion.

Beneath the floor and encircling the entire building, just within the outer wall, is a hot air and pipe duct 4 feet 8 inches high and 7 feet 6 inches wide. Hot air for the heating of the house and engines is driven through this duct by three fans, passes through registers in the walls of the machine shop, also through an air shaft in each engine pit, and is thence delivered to the engine portion of the locomotive. This duct also carries an 8" water supply line, and 3" lines of steam and compressed air. From these lines, and at alternate spaces between stalls, there are hydrant boxes providing 3" taps from the water line, and 1½" taps from the air and steam lines, the piping between the duct and hydrant boxes being through 18" terra cotta pipes beneath the floor.

With their electric motors and radiators, the fans which drive the hot air in the heat duct occupy three fan houses, spaced at intervals on the outside of the house, and built as extensions of the concrete superstructure of the main building. These fan houses are 24' wide, the width of one bay at the outer wall, 22' long, and are designed with beams, girders and slab roofs similar to the superstructure of the main building. At one of these fan houses there is an extension through three bays, providing offices for the roundhouse foreman and his staff. Similar to this fanhouse construction, there is also another extension of the building proper through four bays, for the proposed installation of a boiler wash system, where the blow-off from boilers may



View from the West, St. Clair Roundhouse and Yards During Construction.



Progress View, St. Clair Yards, November, 1911.

be carried to large tanks belows the floors and used for heating, refilling and wash-out water.

For the handling of tender and engine truck wheels there is provided a drop pit running through three of the engine pits, the centre of the drop pit being a circumferential line 22′ 6″ from the centre of the inner columns. The wheels may be lowered by electric driven screw jacks to a truck running on a narrow gauge track in the pit below. This truck may be pushed to an adjacent engine pit, the wheels raised and run off on the tracks of the engine pit. A similar drop pit for the handling of driver wheels, the center line of which is 51′ from the centre of the inner columns, runs through four of the engine pits, the two drop pits occupying but one stall in common.

In connection with seventeen cast iron smoke jacks of the usual type, there are to be installed seventeen jacks of reinforced concrete, it being hoped that this new style of jack will solve the question of obtaining a noncombustible and noncorrosive material for the construction of smoke jacks. Their construction is shown in the illustration. Their simultaneous use under similar conditions will offer a fair comparison of the relative efficiency of these two patterns.

The new power house, located between the proposed shops and the engine house, is about 145′ from the latter and connected with it by means of an underground tunnel 6′ high and 3′ wide, inside measurements, and provides a passage for steam and air lines and allows working space around the pipes of these lines. The power house is 127′x95′, with structural steel frame and brick walls; floor and roof slabs are of reinforced concrete. Outside of the building there are concrete coal bunkers, crossed by an inclined concrete and steel trestle approach for the hopper cars which dump their contents into the bunkers. From these bunkers the coal passes through chutes into the boiler room, and will be deposited directly in front of the four boilers, which, with a 152-foot stack and forced draft, are designed to burn the culm which abounds in this region as waste from the mining of anthracite coal. As the construction of the building has just been completed at this time, and the equipment not yet fully installed, it must suffice to say, without going into detail, that the generators of the engine room will supply power for the lighting of the yards and the various buildings, as well as power for the machine shops, car-repair shops and the air plant.

At the head of the south bound departure yard and to the southwest of the engine house there is a new three-story office building 65′x41′. The frame is of structural steel, walls of red brick, with interior finishing of chestnut. In addition to offices for the assistant train master, master mechanic, train dispatcher, and their clerks, the building provides comfortable quarters for the through-crews, which may be laying over night awaiting a return trip. On the second floor there are pleasant game and reading rooms, lunch room and a fully equipped kitchen; the third floor being devoted to dormitories and locker room, shower baths and toilets.

To the north of the engine house and between the classification and the north bound departure yards there is a new coaling station of the trestle type of 950′ incline approach of structural steel carried on concrete piers spaced 20′ centres. There are two tracks for the hopper cars over the bunker portion of the coaling station, the bunkers providing for the storage of about 1,200 tons of coal, which is delivered to the locomotives by 16 chutes on either side of the dock.

In connection with the coaling station there is a sand-drying room in which the sand is dried and carried overhead by compressed air into bins, from which it is run directly into the sand boxes of the locomotives.

Just below the coaling station there are two water towers, each of 47,000 gallons capacity. These towers are supplied by an 8″ pipe and feed three water columns placed in convenient locations for north and south bound engines on their way between the engine house and the coaling station.

The south bound ash pit is located on the running track between the coaling station and the south bound departure yard. It consists of a system of three tracks, the outer two of which cross pits 175′ in length. The ashes are deposited into these pits and received in small all-steel cars running on narrow gauge tracks within the pits. These cars are later lifted by an overhead crane and their contents dumped in steel cars standing on the track between the two pits.

To form the north bound ash pit the running track to the coaling station is carried on steel girders over a number of brick piers for a distance of 192′ between abutments. The ashes are dropped to a brick platform and from there shoveled to cars standing on a depressed track below, which is constructed with a retaining wall on the ash pit side to retain the filling of the running track. In the case of both ash pits the tracks are open at either end, so that engines may leave in the order of their arrival, and the arrangement is such that they may take water, sand and coal, and deposit ashes in convenient rotation on their way to and from the engine house.

At the upper end of the classification yard there is a new two-story scale office of red brick 47′x43′, which provides for the operating device of the track scale as well as offices for the yard master, weigh master and shipping clerks. This building, as well as that at the lower end of the yard, is heated by hot water, they are roofed with asbestos shingles and their floors have been treated with creosote oil.

Bridges.

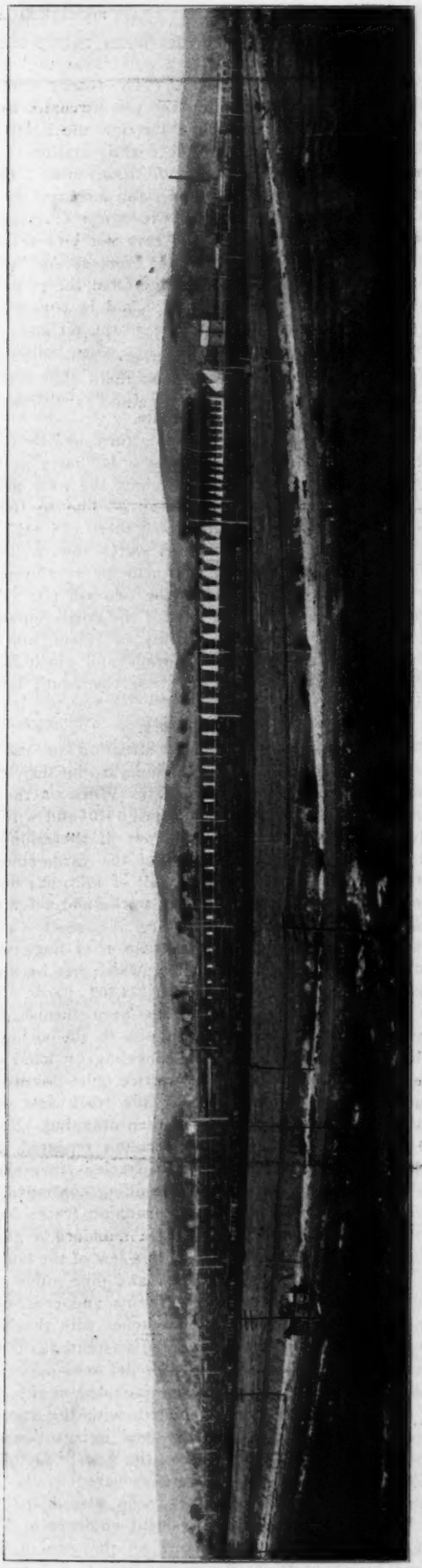
The development of the new facilities has included the abandonment of three grade crossings and the construction of two overhead highway bridges. The new Russell street bridge, spanning the five tracks which connect the south bound receiving and classification yards, is of the through lattice girder type, with 89′ span between the two abutments. At Dormers, spanning two main tracks and 19 of the south bound departure and north bound receiving tracks, there is another bridge of similar design, with three spans of 99′ each. The abutments and footings of piers are of concrete; the piers above footings of structural steel. The highway, for which this bridge provides, is also carried over Mill Creek at this point by a single concrete arch of 44′ span.

At the lower end of the yards there has been completed a double track, three span (28.5 ft.) concrete arch bridge over Mill Creek, and the public road running along its bank. Another single track bridge of similar design, construction of which has been commenced, will form a wye at this point, allowing trains to enter or leave the yards in either direction from the main line tracks, which run nearly perpendicular to the general direction of the yard.

Drainage.

When the track work of the new yard was first commenced, the land of the entire valley was of a very swampy nature and it was first necessary to devise some system of drainage which would dispose of this swamp water, with which the ground throughout the whole valley was saturated. This has been fully accomplished by the construction of an open drainage canal, 8.5′ wide and 3′ high, which runs from the lower end of the south bound receiving yard, along the west side of the yard, as far as the Dormers

Progress View of St. Clair Yards Early in December, 1911.



View of St. Clair Yards from the West, Showing Coal Trestle.

bridge, a distance of some six thousand feet, where it enters a concrete culvert 4'x10', and runs under twenty-one tracks, discharging into Mill Creek at a point near the middle of the north bound receiving yard. This canal drains practically all of the surface water, the ground water being disposed of by a terra cotta line through the centre of the yards from the north end of the coaling station to a point below the engine house, where it drains into Mill Creek. At its beginning this is a 12" line, and increases to 18" and 24" lines after having received the storm drainage of the coaling station and that of the two ash pits respectively. The 24" line receives the drainage from several water columns as well as the storm drainage from the power house, and is increased to two 30" pipes, laid in concrete, below the point where it unites with the storm, pit and sewerage drainage from the engine house and office building. This sewerage first passes through two septic tanks and a filter bed, which lie to the south of the engine house.

Water Supply.

The water supply for the yards is furnished by the Silver Creek Water Company, which has a 12" main at approximately 250 lbs. pressure, running along the west side of the yard. From this main there is an 8" line to the engine house and power house, from which there is a 1½" tap line to the office building. The two water towers below the coaling station are fed from this main by an 8" pipe, which also supplies the water used at the two ash pits. There is parture yard and one to the east of the north bound receiving yard, both supplied from this 12" main, and feeding water columns at the engine storage and north bound re-also a water tower to the west of the south bound deceiving yards.

Track Work.

The yard graduation and construction of track were started on the south bound receiving yard in May, 1909, and completed during the following fall. Work on the classification yard was commenced in April 1910, and with the departure yard was completed and put in operation July 10, 1911. The north bound portion of the yard, construction of which was commenced in the fall of 1911, has been completed with the exception of shop tracks and a few running tracks.

The excavation following construction of track work and changes to public highways, all of which has been used on embankment, was approximately 334,700 yards. The additional embankment required has been furnished in the form of cinders taken from ash pits in the vicinity. The method of unloading has been shoveling by hand or dragging through the hoppers. A practice quite common where found available has been to lay the track first, dropping cinders through the hoppers and then dragging. The tracks are then jacked up and the operation repeated until the tracks are brought to grade. The track is then shifted toward the bank thus made and the filling continued.

All main line, ladder, lead and running tracks have been built with 90 lb. rail and P. & R. standard angle plates; 79 and 76 lb. rails have been used in a few of the body tracks. The ties used were chestnut, oak and pine, none of which have received treatment. All turnouts and cross-overs are tie-plated. No. 8 frogs and 15' switches with the New Century low switch stands were adopted as standards throughout the yard.

All of the 45 miles of trackage included in the plans for the new yards has been completed, with the exception of shop and several running tracks, and it is anticipated that all track work will be finished by the first of October, 1912.

The plans for this work were prepared in the office of William Hunter, chief engineer, who placed the work in the hands of Jos. S. Ward, resident engineer at Williamsport, Pa. Mr. Ward's assistants on the ground, in direct charge, have been W. N. Boyer, and later P. S. Lewis.

GOLD HILL LINE COMPLETED.*

The section of the Panama railroad relocation, known as the Gold Hill line, nine and three-eighths miles long, was formally turned over to the Panama Railroad Company at noon, Saturday, May 25. The large cuts and fills on the new line have been practically completed, and such riprapping of fills as will be necessary, as well as taking up construction tracks, and installing the bascule bridge over the Gatun River at Monte Lirio, will be done by the maintenance-of-way forces of the railroad. While the Naos Island breakwater is under construction not more than two or three train-loads of rock a day can be supplied from Culebra Cut, so that the work of riprapping the fills will probably proceed slowly. The construction tracks in the Gatun valley district will be left where they are for the present, as it is not known what effect soaking with water during the rainy season may have on the heavy embankments, and some supplementary work in this connection may be required. There remains to be laid a permanent track through the dump district, north of Gamboa bridge, and this work will probably be postponed, in the interests of economy, until the central division has finished operations in that section. At the present time, the new line can be utilized for the running of trains for its entire length, but only freight trains will use the road around Gold Hill, the passenger trains continuing to cross to the other side of the canal at Gamboa until such time as it is found necessary to take away the dike, by means of which the crossover is made.

The relocated line of the Panama railroad was made necessary by the plans of the Canal Commission for building an 85-foot level lock Canal. The old Panama railroad was used from Colon to Mindi, five miles, but from that point to Corozal, an entirely new line had to be constructed, for the most part through difficult territory.

The original plan was to have the relocated line cross the Gatun River valley, at Gatun, on an embankment 82 feet high and one and one-fourth miles long. Borings established the fact, however, that the foundation for this embankment would consist of a 20-foot stratum of clay overlying a bed of soft silt, and the idea was abandoned. The construction of a steel viaduct to cross this section was then considered, but on account of the excessive maintenance cost involved, this plan was also given up. In July, 1907, the plan of extending the road east along the north side of the Gatun River valley to a point about one mile from the Canal Zone boundary line, thence building it south across the valleys of the Quebrancha and Gatun rivers on fills having more stable foundations, was adopted. Work was begun on this section of the road, soon after the adoption of the report, by two steam shovels and a piledriver. About the same time tracks were laid from the old main line to points on the relocation opposite Pedro Miguel, Gatun, San Pablo, and Miraflores. In October, 1909, all but five and one-half miles of the line between Gatun and Gamboa had been completed. On March 28, 1910, the ends were joined near Monte Lirio, and on Sunday, May 1, 1910, the first passenger train passed over this part of the line.

It was originally proposed in building the line south of Gamboa to let it follow closely the east bank of the Canal, and to pass through the Culebra Cut on a berm. Owing to the slides that later developed in the east bank of the Canal, opposite Culebra, the plan had to be abandoned. In July, 1910, the committee appointed to consider a new route recommended that the line be constructed back of Gold Hill, which was approved. Construction work was begun shortly afterward, and this section, the last part of the relocated line to be completed, is finished. The line from Paraiso Junction to Corozal was formally turned over to the Panama Railroad

*From the "Canal Record."

on September 4, 1910, and it was placed in operation soon afterwards.

The old line formerly crossed the Chagres River at Barbacoas. It now crosses it at Gamboa, 10 miles further upstream. The Gamboa bridge is 1,320 feet long, and consists of fourteen 80-foot through girder spans, and one 200-foot through truss span. The only other bridge of size along the route will be that over the Gatun River, near Monte Lirio. It is of the bascule, or balanced lift, type, and will rest on piers designed to carry three plate girders, formerly used in the Barbacoas bridge. Pier No. 3 will be used as a trunnion pier, and one of the old plate girder spans will be converted into a lift span by the installation of a lifting mechanism. The piers are all in place, and one of the spans has been laid. While the work is in progress, trains are using a temporary trestle to cross the river bed. The purpose of the lift span is to permit vessels of size to pass through into the east arm of the lake. The other streams along the railroad are crossed in two or three instances by arch culverts; in the remainder, by ordinary culverts. The pavements of these culverts are invariably elevated above the former beds of the streams, in order to procure more stable foundations, and to prevent their being filled up with sedimentary deposits, which would occur at the lower elevations. The road passes through a tunnel at only one point—at Miraflores station. It is 736 feet long between portals, and is lined with reinforced concrete. Excavation was begun on July 1, 1907, and completed on July 9, 1908. The tunnel was entirely completed and ready for use on May 8, 1909.

Month.	Output by cross-section.		
	Earth	Rock	Total
1910.	Cu. Yds.	Cu. Yds.	Cu. Yds.
September	2,725	37,030	39,755
October	7,900	45,109	53,009
November	8,330	45,000	53,330
December	7,000	40,440	47,440
1911.			
January	4,000	53,310	57,310
February	1,345	57,550	58,895
March	5,400	64,200	69,600
April	....	62,540	62,540
May	....	70,030	70,030
June	.....	58,850	58,850
July	.....	57,270	57,270
August	.....	71,550	71,550
September	.....	15,200	15,200
Total	36,700	678,079	714,779

Month.	Output by car report	Per cent of time that shovel worked	No. of working days
1910.			
September	37,840	64.3	20
October	58,030	66.1	26
November	50,020	64.1	24
December	50,660	62.5	26
1911.			
January	56,730	75.0	25
February	60,210	79.9	23
March	67,900	77.2	27
April	61,100	70.7	24
May	72,030	77.6	26
June	65,260	72.4	26
July	62,540	74.6	25
August	76,030	80.3	27
September	15,200	76.9	5
Total	733,550	72.3	304

Note—Average per day, 2,351 cubic yards; output for September, 1911 (5 days) taken from car report. Working days are eight hours.

Record of Steam Shovel Work on the Gold Hill Line, Panama R. R.

In the construction of the road, three systems of labor were tried, one, consisting of carrying on the work by the company's forces; the second, by letting certain sections out to contractors at a fixed price per cubic yard, and the third, by the task method. By far the greater part of the excavation was accomplished by the company's own forces. On March 18, 1908, there were upward of 1,000 men employed on the relocation work, and the highest number at work at any one time was on November 29, 1911, when the force reached 2,514. On May 1, 1912, which practically marked the close of construction operations, there had been excavated a total of 10,168,759 cubic yards; 16,425,292 cubic yards had been placed in embankment fill; 163,908 linear feet of 90-pound, and 64,512 feet of 70-pound, track had been laid.

The best record for steamshovel excavation on the relocated line was made by Steamshovel 257, working in the Gatun section from September, 1910, to September, 1911. This record, contained in the table herewith, is believed to be the best record ever made on the Isthmus, or in the world.

Some serious slides occurred on the relocated line during the process of construction. The plans for a lock level canal required that the new railroad be built two feet above the proposed lake level, which necessitated constructing a high level roadbed through a low level country. The greater part of the time and expense has been necessitated by the crossing of the Gatun valley. From the point where the road leaves the Gatun ridge, to the hills near Monte Lirio, a distance of three and a half miles, the line crosses the main valley of the Gatun River and its several tributaries. In this section there has been placed 5,500,000 cubic yards of embankment. The foundation for some of these embankments was very poor, which necessitated spreading the base of the embankment over a much wider section, in order to reduce the pressure per square foot on the natural ground, and prevent upheaval beyond the toes of the slope.

The total length of the new road from Colon station to Panama station is 47.11 miles. The total cost will be about $9,000,000.

The Chillicothe, Trenton & Cainesville will ask bids in September, it is said, to build a line to connect Chillicothe, Mo., with Trenton and Cainesville, about 75 miles. T. C. Beasley, Chillicothe, is an officer.

The Henderson-Wait Lumber Co. has grading work under way for a logging line from the company's mill near Caryville, Fla., southeast towards Vernon. G. O. Waits, general manager, Caryville, Ga.

MacArthur Bros. Co., Fisher Bldg., Chicago, Ill., has been awarded the contract for constructing the Fort Huachaca branch of the El Paso & Southwestern. This branch is to extend from Lewis Springs, Ariz., to Fort Huachaca, Ariz. The contract includes 150,000 cu. yds. of unclassified excavation.

The Gainesville, Oklahoma & Western has begun work, it is said, on the line projected for some time from Gainesville, Tex., southwest via Era, Slidell, Greenwood and Cowan, to Bridgeport, about 56 miles. H. M. Aubrey, president, San Antonio.

The Georgia Southwestern & Gulf expects to begin work on an extension next fall from Albany southwest to St. Andrews, Fla., and contracts are tentatively let for the work. There will be one steel bridge, 400 ft. long, and two 60-ft. spans. W. M. Legg, president and general manager, Albany.

The Grank Trunk plans to begin work at once on a line from Port Burwell, Ont., northwest via Calton, Aylmer, Mapleton and Belmont, to London, about 40 miles.

Personals

J. C. Mill, signal inspector of the Chicago, Milwaukee & St. Paul, has been appointed assistant signal engineer, succeeding H. K. Lowry, resigned.

A. Swartz has resigned as division engineer of the Erie at Huntington, Ind.

W. L. Rohbock, assistant chief engineer of the Wheeling & Lake Erie, has been appointed acting chief engineer, with office at Cleveland, O., to succeed H. T. Porter, recently appointed chief engineer of the Chicago & Alton.

Carl Gray, Jr., has been appointed assistant engineer of the Oregon Electric and the United Railways. The office is at Portland, Ore.

J. R. Decker, assistant engineer of the Michigan Central at Detroit, Mich., has been appointed division engineer, succeeding E. R. Lewis, who was recently appointed assistant to the general manager of the Duluth, South Shore & Atlantic.

W. L. Rohbock, Acting Chief Engineer, Wheeling & Lake Erie R. R.

B. F. Aikens has been appointed purchasing agent of the Michigan Central, succeeding J. F. Farrel, resigned to accept service with another company. The office is at Detroit, Mich.

L. R. Clausen, superintendent of the Chicago, Milwaukee & St. Paul at Chicago, has resigned to engage in private business.

W. R. Scott, assistant general manager of the Southern Pacific, has been appointed general manager in charge of operation and maintenance, with office at San Francisco, Cal.

C. J. Rogers, acting purchasing agent of the White Pass & Yukon, has been appointed purchasing agent, office at Vancouver, B. C.

William E. Bohl has been appointed acting roadmaster of the Atchison, Topeka & Santa Fe, succeeding Edward Marshall. The office is at Dodge City, Kan.

On account of the death of D. D. Colvin, engineer maintenance of way, F. D. Ritter has been appointed engineer of maintenance of way of the Great Northern division, National Railways of Mexico, office at Mexico, D. F. R. Fabela has been appointed assistant engineer of maintenance of way of the Great Southern division, office at Mexico, D. F.

New Books

HISTORY OF BRIDGE ENGINEERING.

By Henry Grattan Tyrrell; 470 pages, cloth, 6x9; published by the author, Chicago, Ill. Price, $4.00.

This book is a most authoritatively written history of the art of bridge building. It traces the development of the different types of bridges from the earliest known example to the latest concrete arch. The work is, however, more than a history in that it contains the condensed practical information on statistics and costs so necessary to the bridge engineer. Modern development is, of course, given great prominence over that of ancient times, and the steel bridge is very thoroughly discussed in all of its designs, including the truss, girder, suspension, cantilever, arch and trestle. A chapter is devoted to reinforced concrete bridges. Nothing is said as to movable spans, this feature being considered by the author as more properly coming under the head of machine design.

The book contains 330 illustrations, is well indexed, and should be a most useful addition to the library of any railway engineering officer or student.

EARTHWORK DIAGRAMS, by C. A. James, 20 pages, first edition, paper, 10x15 in. Published by C. A. James, White Haven, Pa. Price $1.00

In this book the theory and diagrams are taken up which give a simple method of plotting yardage diagrams for estimating earthwork in cubic yards for any probable width of roadbed, any cut or fill, any ground slope, and ¼ : 1, ½ : 1, 1 : 1, 1½ : 1 side slopes. A method is also given for plotting yard slips for scaling approximate quantities from a profile. The theory is based on simple geometrical principles involving no trignometric functions. The diagrams enable one to obtain accurate tables for any roadbed with any ground slope by using also a table of level cuttings. A complete explanation and demonstration of the theory is given, together with the methods for plotting yardage slips, with illustrations of the latter. The method is very simple and easily understood, and is practically universal in application.

The Maryland Coal & Coke Co., Milton H. Fies, secretary, Birmingham, Ala., is to develop 1,415 acres of coal land in Walker county. The St. Louis & San Francisco early next month will begin the construction of a 6-mile spur to the property.

Judge Jesse McDonald, St. Louis, Mo.; George L. Sands, Eureka Springs, Ark.; W. S. Holt, Little Rock, Ark., receivers, and E. M. Wise, Eureka Springs, Ark., general manager of the Missouri & North Arkansas, have under consideration Harrison, Leslie and Heber Springs as sites for the proposed new shops.

The Natchez, Columbia & Mobile, which operates a line from Norfield, Miss., east to Log Switch, 20 miles, is said to have given a contract to Boyd & Bradshaw, Columbia, Miss., to build a 12-mile extension to connect with the New Orleans Great Northern at Tilton.

The New York Connecting is asking bids for building a 1¼-mile section from a connection with the Pennsylvania Tunnel & Terminal at Woodside avenue, Long Island City, to Stemler street. J. U. Crawford, engineer, Broad street station, Philadelphia, Pa.

The interests of the McIntyre-Mann Timber Land Co. in the Pine Bluff, Sheridan & Southern have been purchased by E. S. McCarty, New Madrid, Mo., president of the St. Louis & Missouri Southern.

CONCRETE DEPARTMENT

Cash Prize Contest on Mixing, Distributing and Placing Concrete.

The contest on layouts for concrete plants and handling concrete in construction, which was announced in the July issue, should bring forth a number of valuable articles. There are very few engineers who are or have been in charge of railway construction who have not had some experience along these lines. And while many are apt to belittle the value of their own experience when it comes to writing such an article, it is a fact that on account of the diversity of practice, nearly any article which could be written would contain some ideas new to many people.

Our idea in this contest is not necessarily to bring out long articles descriptive of specially heavy work, although such writeups are desired and valuable. Small jobs many times give opportunity for a good deal of ingenuity on account of lack of room, lack of or poor equipment, etc. A short article describing such a situation as this makes interesting and instructive reading.

For the two best articles submitted cash prizes will be awarded. The first prize will be $25, the second $15. We will publish most of the articles submitted, and will pay space rates for those not taking prizes, amply repaying you for time spent in preparing same.

The contest will cover the design and layout of a concrete plant, the handling and mixing of aggregates, and distributing concrete for plain or reinforced concrete railway structures of all kinds; foundations, arches, bridges, buildings, viaducts, retaining walls, tunnels, etc.

This contest will embrace problems where concrete is placed: (1) Under ordinary conditions; (2) Under water; (3) Below water line in excavations, or where there is water flowing—in under pressure; (4) In caissons or coffer dams; (5) In tunnel linings. It is not necessary to confine yourself to the suggestions given. Any problems or methods associated with the above subjects will furnish interesting material. Descriptions of original methods will be especially acceptable.

October 1st will be the date of closing the contest, at which time all contributions must be in this office. Address letters plainly to Editor *Railway Engineering*, Manhattan Bldg., Chicago.

Autoclave Boiling Test for Cement.

A NEW requirement or specification which all cement used by the Delaware, Lackawanna & Western must pass is as follows:

> Portland cement used shall pass 78 per cent through a 200-mesh sieve instead of 75 per cent as demanded by standard specifications of American Society of Testing Materials. Cement shall remain sound after being subjected to boiling under pressure of 20 atmospheres for a period of 2 hours in an autoclave, a metalic vessel, gas tight when closed, used for heating liquids under pressure.

The reason for this seemingly rigid or radical requirement was the result of an investigation by H. J. Force, chemist and engineer of tests, into the causes of disintegration of numerous concrete structures along the lines of the Lackawanna, after which it was concluded that there was still room for improvement in Portland cement, though the great majority of manufacturers and users are satisfied to manufacture and use it without trying to have or insisting on having better cement.

The failures examined were classified under three heads, viz.:

1. Those due to poor sand and stone and poor mixing.
2. Those due to freezing of concrete before final set; the use of calcium chloride, and hot weather concreting where initial set is acquired before placing.
3. Those due to green, unseasoned, and improperly manufactured material.

Although a great number of the failures were due to the first two mentioned causes, many of them, where the materials and workmanship were known to be of the very best obtainable, could only be laid to some unknown fault in the cement. In these days when such enormous amounts of cement are used, about the only tests besides tensile tests, which the user has time to make, are the accelerated tests; naturally therefore, the boiling test was made the main point of the investigation. A laboratory was established and the autoclave test was the outcome of the investigation.

The failure to pass the ordinary boiling and the autoclave test is, according to the investigators, due not to the free lime or magnesia content in the cement, but to a certain kind of coarse granules which fail to pass the 100-mesh sieve and a part of the material failing to pass the 200-mesh sieve. A briquette made of cement containing these granules, probably a hard-burned clinker, when tested in the autoclave, swells, disrupts and absorbs moisture, due to the breaking up of these coarse granules. The action being the same, but very much more rapid, as that which takes place in structures where cement containing comparatively coarse granules absorbs enough moisture, after a period of a year or two, to disrupt the granules and cause the incipient failure of the structure.

An interesting feature disclosed by the tests was that cement briquettes passing the autoclave test show a decided increase in tensile strength after the test. This test being in a way one of constancy of volume, it is to be expected that no decrease, but rather an increase in tensile strength would take place in cement passing the test.

That the requirement is not very hard to fulfill by the manufacturer is shown by the tables of tests of materials from different mills. In one case the tests of the first two lots from a certain mill went to pieces when tested; a complaint was entered and every succeeding lot passed the test very successfully, a notable fact being the fineness of the cement, an average of about 80 per cent passing the 200-mesh sieve.

All the finely ground cements, however, did not pass the tests, showing that something besides coarse granules causes failure when put to the autoclave test. In most of such cases the failure was traced to poorly manufactured and unseasoned clinker.

It is now universally granted that the fine material in cement is the part that enters into the reaction when setting takes place. Therefore, any coarse material which is not broken up and does not acquire the proper amount of moisture in mixing, only weakens the concrete, renders it less constant in volume and subjects it to slow disintegration with age due to absorption of moisture.

Although it appears from these tests that better cement can be obtained very readily by finer grinding, we do not believe that other factors, such as mixing the materials in manufacture, burning of clinker and seasoning of clinker before grinding, should be overlooked. It is a fact that cement clinker, if stored for a considerable time before grinding, does not tend to disrupt so easily when subjected to the accelerated tests. In this age, when everything is sacrificed for speed, it is not surprising that cements are not what they could or ought to be. The manufacturer, true to the spirit of the times, will speed up the output of his plant, if the occasion demands, and in all cases the ultimate consumer "pays the fiddler." Several manufacturers have very wisely installed the autoclave tests at their plants, which goes to show that it has possibilities; others, however, of the "stand-pat" type consider it only a seasonable fad which will soon be dropped.

Concrete has been called a permanent material, and it is, within certain limitations, when all materials entering into it are of a lasting quality. We cannot hope, however, to make a lasting material of any combination of substances when the principal ingredient is not durable, which is true of neat cement at the present time.

The autoclave test, although it may seem very rigid and severe, because of the ability to detect thereby unseasoned, poorly ground and slow hydrating cement, we believe is a step toward the ultimate goal of the cement industry, cement with lasting qualities.

Concrete Practice, Grand Trunk Railway

The Grand Trunk Railway structures described and illustrated herein are of plain concrete, it being the policy of this road to use reinforced concrete in special cases only.

Straight and Wing Abutments.

Straight and wing abutments of concrete (not illustrated) are, in general, built vertical or with a face batter of 1 in. in 12 in. The backs of abutments are always stepped, the profile having an approximate batter of 3 in. in 12 in. The backwalls are made 10 in. to 12 in. wide on top, sloping down with 6 in. or 8 in. batter to the bridge seat. The ratio of base to height is taken as 50 per cent.

The forces assumed in design as acting on the abutment are Cooper's E-50 live load with impact percentage according to formula:

$$\text{Impact} = \frac{L^2}{L + D}$$ where L = live load and D = dead load.

Earth pressure is obtained from Rankine's formula for surcharged walls.

Plain Concrete U-Abutment.

The abutment shown is of concrete of a 1 : 2½ : 5 mixture. The main portion or breast wall rests on a footing course 5 ft. thick founded on piles, cut off 12 in. above the bottom of footing. The footings for wings are stepped to follow very closely the surface slope. Piles are not used for wing footings unless foundation is soft and even then are not used in upper steps unless ground holds water.

The abutment and wing faces are battered ½ in. in 12 in. The backwall, which is a continuation of abutment, is vertical and extends 12 ft. above the bridge seat, which is 4 ft. 3 in. wide. The face of backwall for this type of structure is usually vertical on account of the low bridge seat. The back of breast wall and wings is stepped, as shown in sections. The ratio of base to total height for breast wall is 35 per cent, and for wings from 40 per cent to 50 per cent.

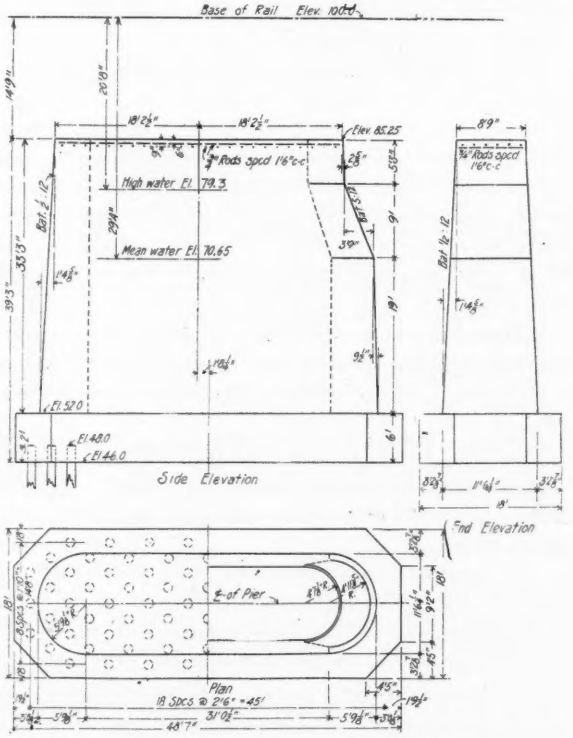
No provision is made for taking care of expansion and contraction between front of abutment and the wings. The edges of wings and bridge seat have a 3-in. chamfer.

For design, the forces assumed as acting are the same as given above for straight and wing abutments. The approximate yardage of concrete required for this U-abutment, shown herewith, was 292 cubic yards.

Plain Concrete Piers.

Bridge piers are built of 1 : 2½ : 5 concrete. The stone used is required to pass through a 2½-in. diameter ring, and to have all dust screened out.

The footing of pier shown is 6 ft. thick with a capping of 4 ft. over piles. The unusual thickness is due to the wide



Concrete Bridge Pier, Grand Trunk Ry.

projection (3 ft. 3 in.) beyond base of pier. The pier, with the exception of the starkwater, is battered ½ in. in 12 in., the ends of pier being round. When starkwater is not necessary, both ends of pier are made round and battered the same as the sides. The batter of starkwater for this pier is 5 in 12 for a height of 9 ft. or to a point about 1 ft. above high-water mark; above this the usual ½-in. batter is used.

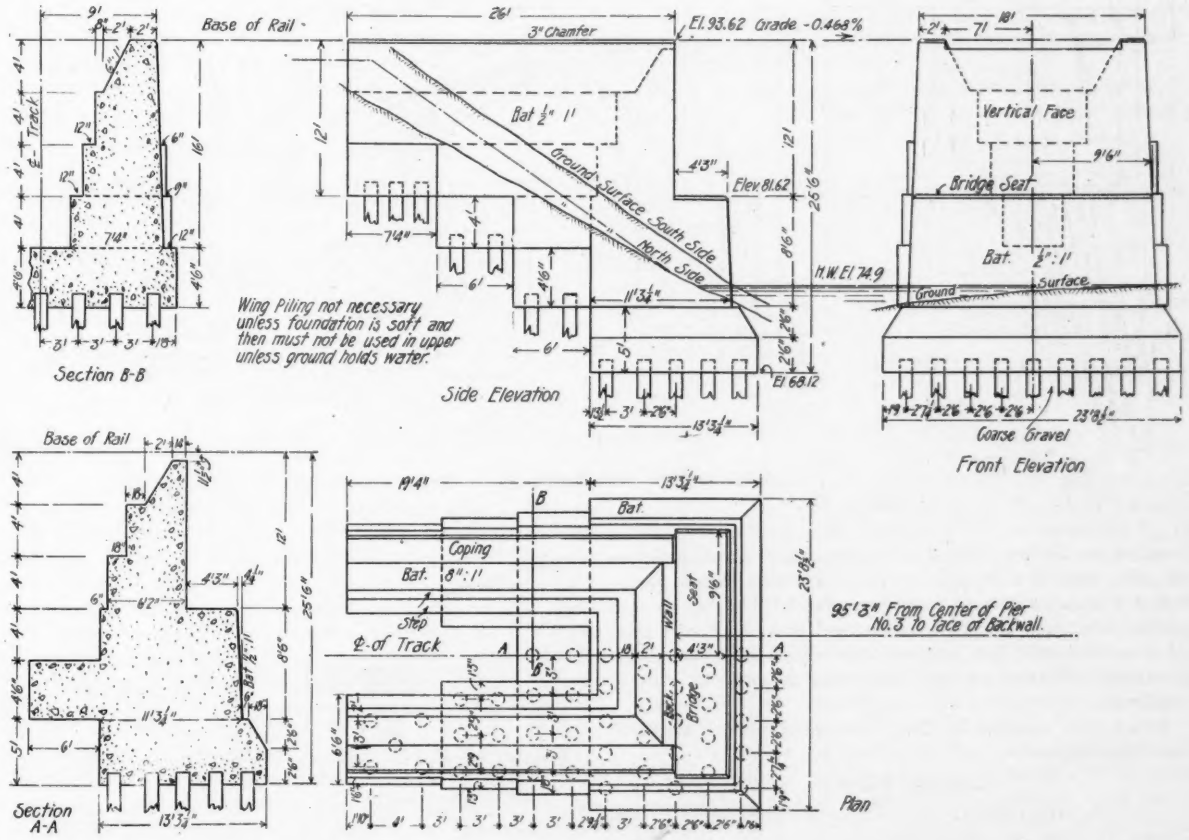
The usual practice is to run the starkwater from top of footing to top of pier with 3-in. to 4-in. batter. The top of pier is reinforced with ¾-in. rods spaced 18 in. on centers both ways, the top layer being 6 in. below surface.

The forces assumed as acting on a pier are Cooper's E-50 live load with impact; dead load, weight of pier (concrete weighing 150 lbs. per cubic foot), and the weight of the superstructure. Ice and wind pressure are also assumed in design.

on ring head, a detail of which is shown. The edge of intrados is given a ½-in. chamfer. The spandrel walls are of the gravity type with vertical face and have a back batter of 4 in. per foot. The spandrels have a 2 ft. by 2 ft. coping, with a 3-in. chamfer at edge.

The backs of abutments are battered 3 in. in 12 in. The wing walls are of a heavy gravity section, the base being nearly 50 per cent of the height. The face batter of wings is 1½ in. per foot on square, and the back is battered 4 in. in 12 in. for a height of 5 ft. at top and then stepped until desired size of base is obtained. Inside edges of wings are chamfered.

The waterproofing specified was hot coal-tar pitch or soft soap and alum with 1½-in. cement covering. Occasionally layers of tar felt are used, depending on the season of the year.



Plain Concrete U-Abutment, G. T. Ry.

Piles are used where the foundation is not of a compact nature, the maximum allowable load on piles being 20 tons. Where piles are not used, the bottom of footing must be at least 4 ft. below surface of ground, and more if there is any danger of scour.

Plain Concrete Arch Bridge.

The bridge illustrated is a circular arch of 20-ft. span with solid gravity spandrel to hold earth fill and ballast.

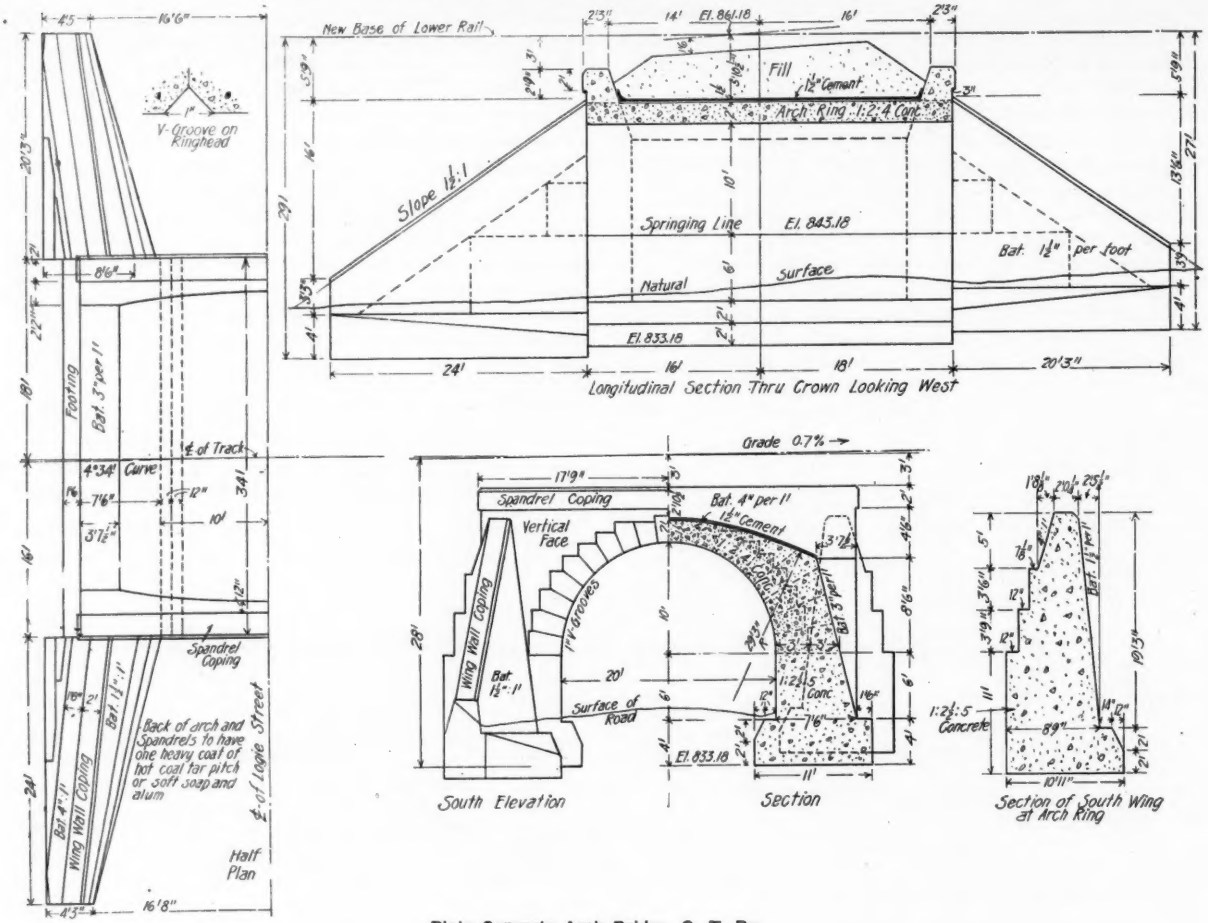
The concrete used for footings and abutments to springing lines and over arch ring was a 1 : 2½ : 5 mixture, same mix being used for wing and spandrel walls. The arch ring is of 1 : 2 : 4 concrete 24 in. thick at crown ring, backing laid up radially, as shown, in section. The ring head is flush with vertical spandrel wall, the appearance of radial voussoirs or ringstones being obtained by 1-in. "V" grooves

Designing loads were: live load, Cooper's E-50 with impact; dead load, earth 100 lbs., and concrete 150 lbs. per cubic foot. Rankine's formula for earth pressure was used in design of wings.

Steel I-Beam Span Protected by Concrete.

The bridge shown is a 15-ft. clear span I-beam structure on plain concrete abutments, founded on piles.

The bottom is a concrete invert 1 ft. 3 in. thick at center with 4 ft. 6 in. baffle wall at ends to prevent scour. The concrete abutments are first built up to the line of bottom of I-beams, the I-beams are then placed, and the remainder of the concrete forming the slab is placed in one operation. The 20-in. I-beams are tied together at ends with ¾-in. diameter tie rods fitted with four nuts. Dowel bars 2 in. long are placed in abutments at points between bearings of



Plain Concrete Arch Bridge, G. T. Ry.

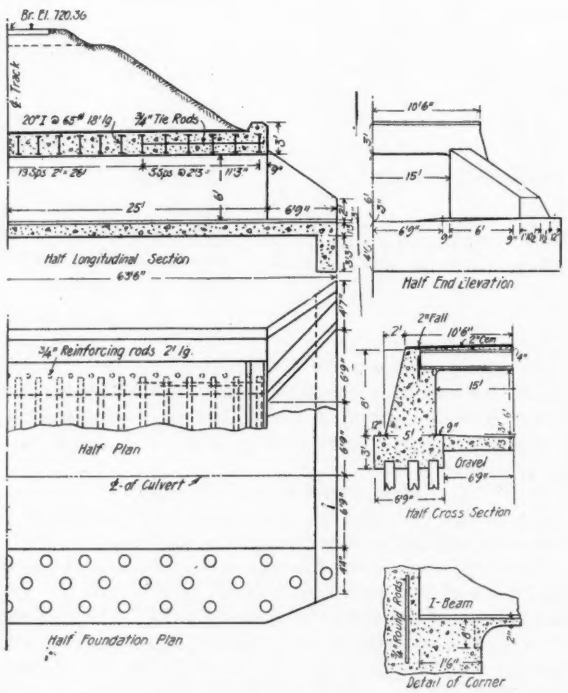
I-beams, to tie the slab to the abutments. The thickness of cover slab is 2 ft. 2 in., 2 in. of concrete being placed below I-beams and 4 in. above, at center. The top of slab pitches 2 in. each way from center and is covered with 2 in. of grout mixed 1 part cement and 1 part sand, as waterproofing. A small parapet is formed at ends of slab to retain fill.

The forces assumed in design are as stated for the arch described above.

Concrete Culverts.

Concrete arch culverts are used to a considerable extent. These culverts are practically plain concrete although a little reinforcement is added in some cases. Box culverts are also used. The reinforcement for these structures is plain square bars of medium steel. The unit stresses used are 16,000 lbs. per square inch for steel in tension and 500 lbs. per square inch compression in concrete. The live and dead loads used in design are same as noted under plain concrete arch.

Steps are being taken by the business men of Platteville, Cuba City and Benton, Wis., to organize a company to build a steam railroad to a connection with the Illinois Central either at Apple River or Scalesmouth. F. J. Becheley, formerly superintendent of the Illinois Central, with headquarters at Duluth, has been placed in charge of the work by the citizens of the towns interested.



I-Beam Span, I-Beams Encased in Concrete, G. T. Ry.

The Signal Department

FUNDAMENTAL PRINCIPLE AND CONTROL OF AN AUTOMATIC SIGNAL SYSTEM.

B. M. Meisel.

This article starts out with elementary details, but is to be followed by others which will take up special automatic wiring problems.

The control of an automatic signal system is embodied in the track circuit, which is the fundamental principle on which the operation is based. A diagram of a simple track circuit is shown in Fig. 1. The tracks are divided into sections by insulated joints as shown at C, C^1, C^2, C^3. These sections are called blocks, or track sections. At one end of each track section an electric battery, usually composed of two cells of gravity connected in multiple, is placed in a battery chute. The copper, or positive side of the battery, is connected to one rail by means of an insulated copper wire, and the zinc, or negative side of the battery, is connected to the other rail in the same manner. At the opposite end of each section an electro magnet, which operates on its armature a number of circuit breakers, is connected to the rails, as shown in Fig. 1 at A, A^1, A^2. This piece of apparatus is called a track relay. Referring to Fig. 1, it will be noted that positive battery, B, B^1 and B^2, flows through rails d, e and f to relays A, A^1 and A^2, through the relays and back to negative battery through rails g, h and i, thus energizing the relays; this closes or opens the contacts on the relays depending upon whether they are front or back contacts. It is through these contacts that the controlling circuits for the signals themselves pass, both local and from a distant point.

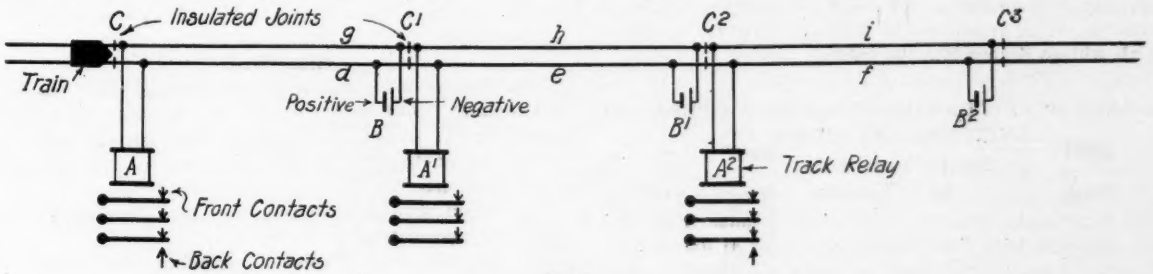


FIG 1.
Simple Track Circuit.

In order to insure the best working condition, all rails, not including those at the insulated joints, are bonded together with two galvanized iron bond wires which are fastened into the rails, that have been drilled to the proper size, by means of a special rivet or channel pin. By this means the electrical resistance of the rails in a track section is reduced to about two ohms. This resistance, of course, varies according to the length of the track section and the condition of the splice bars, etc. The circuit condition of any track section depends also upon the track ballast; that is, the amount of battery current that will flow from one rail to the other through the track ballast depends upon the kind of ballast, the kind and condition of the ties, and whether both are wet or dry. The smaller the amount of current that flows from one rail to the other through the ballast, the longer the track section can be made. The usual length is about one-half a mile. The track relay usually has a resistance of four ohms, so that the total external resistance of a track circuit is from 4 to 6 ohms.

As a train passes the insulated joints at C and enters the section C, C^1, an easier path for the current from battery B is provided through the wheels and axles of the train, so that the current now flows from positive battery B through rail d to the wheels of the train. Here the current divides, part of it continues through rail d to relay A through relay to rail g and back to battery; and the remainder takes the new path through the wheels and axles of the train to the rail g and back to battery. Here we have what is known as a divided circuit and the amount of current in each path depends upon the resistance of the path. Since the resistance of the wheels and axles of the train amount to a very small figure as compared to the relay resistance, it follows that the current in the relay will be reduced to a very small quantity, which is not enough to hold up the armature of relay A. Hence it drops away, and all circuits that were formerly closed through the relay are opened. When the last wheels of the train pass out of section C, C^1, relay A will be energized sufficiently to pick up its armature and close the contacts again. So in this way we have the fundamental control of an automatic signal system, "the track circuit."

Next in order comes the signals and their circuits. The simplest circuit for the control of an automatic system of signals comprising a home and distant for each block, is a normally clear circuit, as shown in Fig. 2. As the name implies, the normal position of the signals controlled by this circuit is the clear, each signal assuming the danger position immediately after a train passes it, and returning to the clear position after the last portion of the train passes out of the block governed by that signal. Figure 2 is a diagram of a normally clear circuit with a home and distant arm on each mast. This condition usually exists when the traffic on the section of road protected is frequent and the signals are relatively close together.

The circuit for the control of the home signal A may be traced as follows: Starting from the positive side of battery B the current flows through wire *1*, magnet H, front contact C of track relay, wire *2* to the negative side of the battery. Magnet H will therefore be energized as long as contact C is closed. This magnet H is the controlling magnet for the home signal and when the magnet is energized the home signal is in the clear position. The same is true for magnets H^1 and H^2 at signals A^1 and A^2. In like manner magnets D, D^1 and D^2 control the position of the distant signal arms on the same masts with home signals A, A^1 and A^2. Contacts J, J^1, J^2, J^3, J^4 and J^5 are operated by signals A, A^1, A^2 and A^3, and are closed only when the signal is clear. The circuit for the D magnet which controls the distant signal on the same mast with signal A may be traced as follows: Starting at positive battery B^1, at signal A^1, the current flows through wire *3*, contact J^2, wire *4*, contact C^3, on track relay at signal A^1, wire *5*, *6*, *7*, contact C^2 on track relay at signal A, wire *8*, contact J, wire *9*, magnet D, wire *10*, *11* and *12*, to negative battery. In like manner the circuits for the control of magnets D^1 and D^2 may be traced. If a train is in the block between signals A^2 and A^3, a study of the above circuits will show that signals A^2 and the distant signal on the same mast

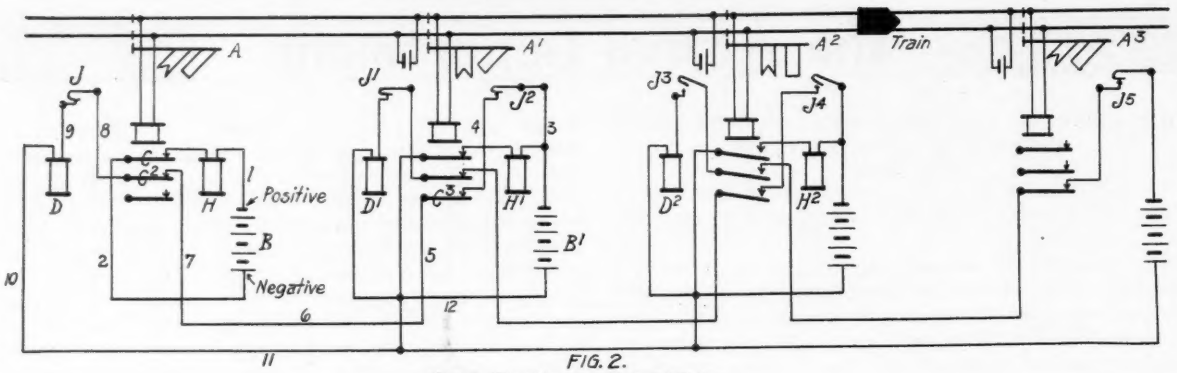


FIG. 2.
Track Circuits and Signal Wiring.

will indicate danger and caution. Signal A^1 will be clear and the distant signal below it will indicate caution. Signal A^2 will not clear until the last wheels of the train have passed the insulated joints at signal A^3. And when signal A^2 is clear then the distant signal below A^1 will clear.

The writer offers the above article merely as an elementary study to those desiring an idea as to the workings of an automatic signal system and offers apologies to those proficient in the art. This article will be followed, however, by others which will go deeper into the subject.

DOUBLE-WIRE TRANSMISSIONS FOR OPERATING SWITCHES AND SIGNALS.*

Belgian State Railway.
By J. Verdyen.

Up to 1903, the administration of the Belgian State Railway used iron wire 3 millimetres (⅛-inch) in diameter for the single-wire transmissions for operating signals.

At that period, the attention of the administration was drawn to the fact that many irregularities in the train service were caused by signals flying to "danger" at wrong times in consequence of the fracture of such transmissions.

It was then decided gradually to replace the single-wire transmission for operating signals by double-wire transmissions and gradually to replace the iron wire by very strong galvanized wire made of cast steel.

One sole trouble arose when the new metal came into use; great care was necessary in making the twisted joints which then were the only ones used, so as to avoid damaging the metal. In spite of the instructions given to the staff and although special suitable tools were provided for the purpose, numerous fractures still took place at the joints, made with the 3-millimetre (⅛-inch) wire then used. Twisted joints were difficult to make in the case of 4-millimetre (5/32-inch) wire and quite impossible in the case of 5-millimetre (13/16-inch) wire. With such thicker wires it was necessary to use German soldered joints which were expensive and difficult and troublesome to make. This disadvantage has been entirely overcome by the use of the new Ponsart joint described below.

*From a Bulletin of the International Railway Congress.

Steel Wire.

The Belgian State uses steel-wire transmissions, made of 5-millimetre (13/64-inch) wire, for the operation of switches; those for the operation of signals are made of steel wire 3 or 4 millimetres (⅛ or 5/32-inch) in diameter, according to the distance.

This steel wire is well galvanized and must satisfy the following specification:

1. The steel must harden if quenched after heating to cherry red.

2. The ultimate tensile strength shall be 125 to 130 kilograms per square millimetre (177,785 to 184,900 lb. per square inch), with a maximum elongation of 4 to 5 per cent.

3. The number of successive bendings to the right and to the left, which the steel wire shall support without breaking, the jaws of the vise being rounded to a radius of 10 millimetres (25/64-inch), shall be twelve to fourteen in the case of wires 3 millimetres (⅛-inch) in diameter and eight in that of wires 4 and 5 millimetres (5/32 and 13/64-inch) in diameter. The wire must also stand the bending, twisting and coiling necessary for making the joints; in particular, it must stand coiling around a cylinder of a diameter equal to that of the wire, without showing cracks, flaws, pinholes, or damage to the coating.

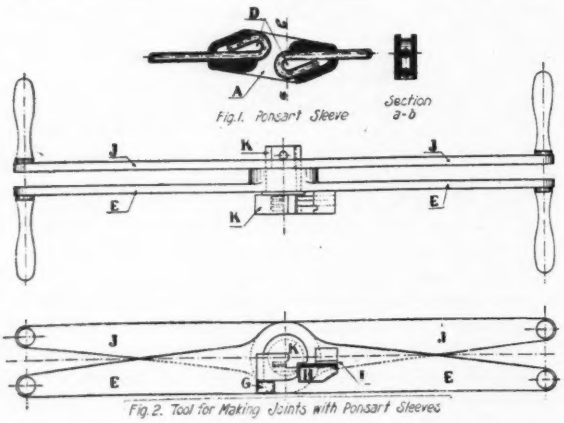


Fig.2. Tool for Making Joints with Ponsart Sleeves

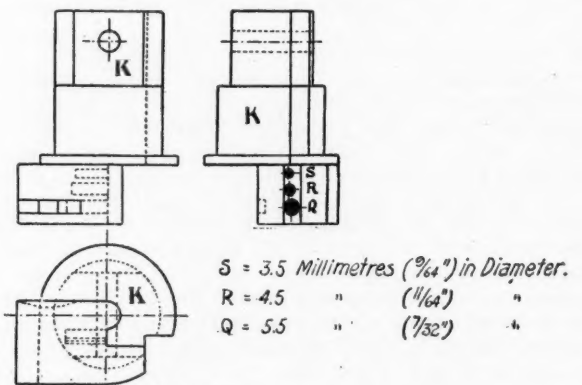


Fig.3. Detail of Pivot "K"

4. The galvanized zinc surface must be free from spots, flaws, or irregularities. The wire is not received, from the point of view of the galvanizing, unless it can stand six successive immersions of one minute each in the case of 3-millimetre (⅛-inch) wire, seven in that of 4-millimetre (5/32-inch) wire and eight in that of 5-millimetre (13/64-inch) wire, in a solution of one part of copper sulphate in five parts of water, without exposing the surface of the iron and without reddening, even partially; the wire used for these immersions shall be coiled on a cylinder having a diameter equal to ten times the diameter of the wire.

The Belgian State Railway has temporarily modified the clause relating to the strong galvanizing, the Belgian manufacturers not yet being equipped to supply it. The clause accordingly now includes only five immersions at the temperature of 15 deg. C. (59 deg. Fahr.) in the copper sulphate solution.

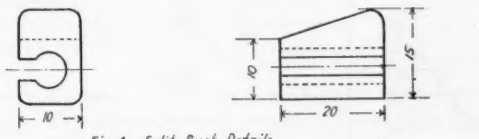


Fig. 4. Split Bush Details.

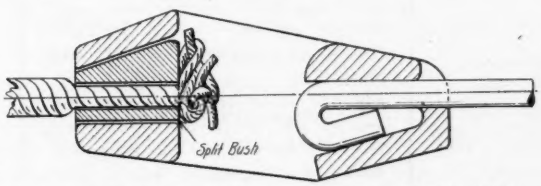


Fig. 5. Fixing the Wire Rope in the Sleeve by means of a split Bush.

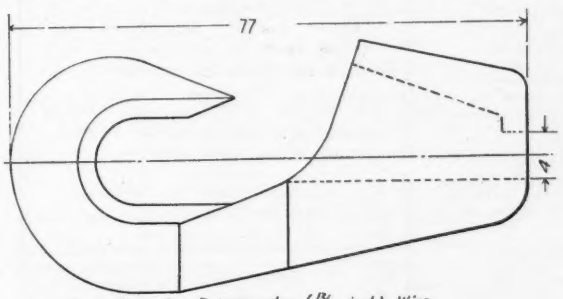


Fig. 6. Hook for 5-Millimetre (13/64-inch) Wire.

Wire Ropes and Chains.

At very tortuous parts of the transmissions, and also at the return sheaves and compensators, wire ropes and chains are used.

The wires ropes are of galvanized cast steel, and are 6.9 millimetres (17/64 inch) in diameter. They are formed of six strands of twelve wires and of seven hemp cores. The ultimate tensile strength must not be less than 1,700 kilograms (3,748 lbs.) and the elongation must not exceed 4 to 5 per cent. The chains which must be to gauge are made of iron welded by hand, or of steel welded electrically. Their ultimate tensile strength must not be less than 1,800 kilograms (3,968 lbs.). The electrically-welded chains ordinarily supplied have a considerably greater strength and their price is generally lower than that of hand-welded chains.

Joints.

From 1909 onwards, the Ponsart joint has been used on the Belgian State Railway. It consists essentially of a metal sleeve (Fig. 1) in the hollows of which the ends of the wires which are to be joined become wedged or jammed by the pull acting on the wires. For this purpose, the ends of the wires are bent double by means of a special tool.

In making this joint, the end of one of the wires is introduced in the sleeve A and bent so as to form the loop D; it is then pulled back into the conical hollow in sleeve A. The end of the second wire is then treated in the same way.

Figures 2 and 3 show the tool for making the loop D. It consists essentially of a lever E with two stops G and H, and a series of grooves suited to the diameters of the wires; a second lever J can turn round the pivot K through which cylindrical holes are drilled having the same diameter as the wires which are to be bent.

In order to make the loop D, the end of the wire is passed through the slot I and one of the holes in the pivot; the lever J is then turned through an angle of 180 deg., the wire is then pushed back from right to left so as to bring it against the stop H. Then the lever J is again turned to the right, so as to form the loop D.

This operation is very easy and very simple in practice; it only requires the co-operation of two men for a few minutes and it can be quickly carried out at any time, in the night as well as in the day, without any special preparation.

In order to connect the wire ropes with the wires, a sleeve is used. The dimensions of the sleeves vary with the diameter of the wires which are to be joined. The end of the wire is bent as already described. The end of the rope is first of all placed in a split elastic taper bush (Fig. 4), the six strands are then walled and crowned, as shown in Fig. 5. This wall and crown knot secures the rope to the bush and this is then pulled back into the conical hollow in the sleeve. The greater the pull on the rope, the more the elastic bush is compressed.

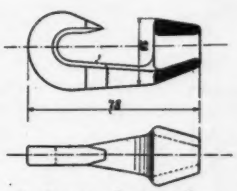


Fig. 7. Hook for Wire Rope.

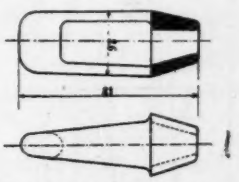


Fig. 8. Eyelet for Wire Rope.

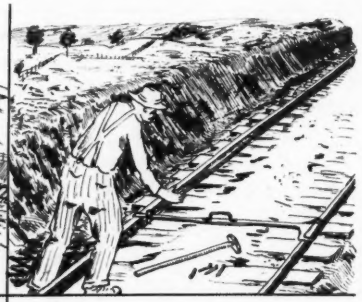
The wires and wire ropes are connected with the chains by means of hooks (Figs. 6 and 7).

There are also eyelets for the wire ropes (Fig. 8).

The new system of joints became extended very quickly on the Belgian State Railway, and experience has shown that fractures in the transmission lines never occur at the joints.

An American consular officer has forwarded a report regarding a comprehensive plan of a foreign government for railroad buildings, harbor construction, and other public works involving the expenditure of considerable sums of money. As a field for profitable investment the consular officer believes this proposition is particularly entitled to consideration and should receive the careful attention of American capitalists. The official in charge of this matter is favorable to American participation, and the time seems especially opportune for action. Further details can be obtained from the Bureau of Manufactures, Circular 9099.

The Virginia-Carolina plans call for building an extension from the mouth of the Green Cove creek to Boone. It has not yet been definitely decided when bids will be asked for the work, which will be largely through a mountainous section. P. W. Early, chief engineer, Abingdon, Va.



The Superintendent

For he carried water, day after day
And all he earned was very small pay
But he worked with a will, and
The time was not long,
Before he was in charge of the
whole Section.
He labored at this with zeal a vim
Until the Officials made a
road master of him.
Now with great achievements, his
mind was bent,
And he stands today as the
Superintendent

Mike (attending a funeral of one of his comrads, while looking at the many floral pieces, discovered one in the shape of an anchor and with a look of surprise exclaimed) " I wunder who ain't that pick"

"Dinny sez"

"If I put in that piece of thrack according to the injaneers shtakes a train wouldnt shtay on the threck."

"Always remimber a thrack cant roon shtraight from a number four frag.

Whin they bees a cutting your gang down to two min the chances for having a premium siction are poor indade.

With yer new fangled concrate ties and all the rist of the new patents and all the Ginnys and Grates to look afther certainly kapes one busy these days.

What an injaneer dont know about poozle switches and frags cil fill a book as thhick as me hat.

Are all the men I dont like hanging around whin I'm puttin' in a father thrack its an injaneer.

Now hurry up an take that jack from oonder that that thrack, Noomber tin is on the curve right now. M.G.

Pat (calling the waiter back) Bring me a hod of ice cream!
Waiter (disgustingly) We dont sell ice cream in bricks sir.

"THE CALL"

I remember me bye long long ago,
In the days of fifty one,
When I left my home and heitve land
And wint toward the sitting sun.

A few years later I was in my teens,
And work I had to find,
So I struck out West with shoulders broad
An' rail-roading on my mind.

I landed a job as water biy,
On a big road that ran out West,
And I stayed with thim for many a year,
An' my name wint up the list.

Mean while I grew both big an' strong
An' on the siction I had a place
An I worked right hard from early down
'Till the sun had hid his face.

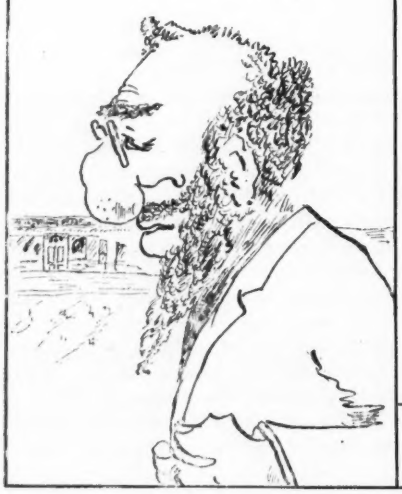
Things wint this way for a long long time,
Untill our foreman McCain,
Lost his life one night while walking thrack,
Against a hard an' driving rain.

So I moved along to a better job,
As foreman of the gang
And I kipt my place with honest work,
Till age an pinsion moved me on.

An' now as I look back upon
Those good ould days of yore
It makes me feel a kind o'sad
For me days of railroading are oer.
M.S.G.

"ITS A BIZNESS"

Say Rubinski ver you a Roosevelts ruff ridairs?
No saree, I am an asfelt smooth walkers.



For years of service, conductors wear stripes upon the sleeve of the coat, engineers and trackmen have their stripes on their back "Stripes of grief."

Instrument Man. – I see the'r sending me a sample copy of the LITERARY DIGEST. Rodman – Hope you'll be a good fellow Bill and divy up; I aint digested anything I speak of for a week. J.J.S.

The Maintenance of Way Department

Contest on Labor Articles.

The contest which closed July 15 brought out 51 contributions, the largest number ever submitted in such a contest for maintenance men.

The judges in the contest were: H. J. Slifer, general manager of the Chicago Great Western; A. S. Kent, chief engineer of the Chicago, Indianapolis & Louisville, and L. C. Ryan (roadmaster C. & N. W. Ry.), secretary of the Roadmasters' and Maintenance of Way Association. We are greatly indebted to these men for the time spent and the careful consideration given the papers submitted.

Following is a list of those who submitted articles: J. D. Archibald, assistant supervisor track; J. J. Bethune, roadmaster; R. P. Black, engineer maintenance of way; Wm. E. Bohl, roadmaster; C. E. Boone, roadmaster; J. T. Bowser, chief clerk, engineering department; Thomas Brannan, roadmaster; L. Brumaghim, supervisor of track; E. Butcher, roadmaster; Thomas Cain, foreman; S. Cheatham, roadmaster; William Christensen, foreman; C. Clay, roadmaster; A. M. Clough, supervisor of track; J. R. Coulson, roadmaster; F. E. Crabbs, roadmaster; H. D. Cramblit, foreman; J. H. Cummings, roadmaster; A. M. Foote, chief clerk, maintenance of way department; J. P. Haddix; P. H. Hamilton, foreman; D. T. Harvey, supervisor; C. C. Henkel, foreman; J. J. Hess, roadmaster; Thomas Hickey, roadmaster; B. M. Hudson, general foreman of bridges and buildings; E. G. Lang, inspector of roadway; O. A. McCombs, roadmaster; Allen McGill, foreman; J. D. McRae, refrigerator inspector; E. J. McVeigh, storekeeper; John Mitchell, foreman; E. W. Miller; J. J. Morgan, storekeeper; J. N. Newson, foreman; D. O. Hern, roadmaster; L. I. Olson, foreman; Andrew Palm, roadmaster; F. M. Patterson, assistant engineer; Warren Peachey, supervisor of track; S. B. Peter, roadmaster; J. M. Podmore, division engineer; George J. Sharkey; T. F. Stewart, roadmaster; L. W. Strayer; D. Taylor, roadmaster; W. A. Trimble, clerk to supervisor; C. L. Van Auken, assistant engineer; W. K. Walker, division engineer; T. W. Whitney, supervisor of track and J. C. Wilson, foreman.

On account of the large number of excellent articles submitted, it will be impossible to announce the winners of the prizes in this issue.

ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION.

Annual Convention September 10, 1912.

The Roadmasters and Maintenance of Way Association will hold its 30th annual convention at Hotel Statler, Buffalo, N. Y., Sept. 10, 1912. A number of interesting committee reports will be presented.

A large attendance is expected at this convention. The officers have been exerting themselves to make the attendance the largest in the history of the association.

The convention city, Buffalo, could hardly be located in a place of more interest. Between sessions there will be time to see Niagara Falls and all the interesting sights associated with it. The program committee has not slighted the amusement features, but has made ample provision for entertainment in addition to the convention meetings.

RAILWAY TRACK LABOR.

E. J. McVeigh.

When the man who handled track labor twenty years ago stops to consider, and compare, the conditons then existing with the conditons of to-day, and hopes for the future, he must feel that *his* day for "doing things" has gone by, never to return. Moreover, it is hard to "teach old dogs new tricks," and many of the older roadmasters are really more pessimistic than they need be. In this matter we are, as in all other matters, in a state of evolution, and we must conform, or be left on one side, while younger men, men of the hour, carry on the work under the conditions *they* find, as the older men did in their day and generation. That conditons are different and more difficult is perfectly true, but conditions have changed in all lines of human effort. Life has become more strenuous all along the line, and where brawn fails us, we must use our brain to make life possible.

That we have done this is seen clearly on all sides, and no where more than in the construction and maintenance of railway permanent way. Our machinery for loading, unloading and spreading ballast and handling material shows this. In the portion of our country where the fall of snow is heavy we handled it by hand in the past when hands were many and willing; to-day we have other means to do it better with fewer hands, and it will be so to the end, which is not yet, and in the meantime we must live in the present and prepare for the future.

If we glance back over the railway history of this continent we will learn that when we wanted men for our track work they were recruited largely from the native stock, farmers' sons, the most intelligent and best trained labor the world has ever seen. In the early days of railroad laboring, work off the farms was not so plentiful as it became letter, so that these young men were more than willing to take up track work. And they, with their natural intelligence and ambition, soon became expert in their work and proud of it. Many spent their lives at it, and it is from this number that our present day roadmasters and supervisors largely came.

But time flies, and as our country advanced and opened up, opportunity for this class of men increased, the railways did not fully realize the position, and did not increase wages fast enough to hold them. Whether they could in any case have held them in such a country as ours is a question, but the fact is they did not, so that to-day we are confronted with a fact and a condition. It is with the condition created by the fact that we must deal, now and in the future. Go ahead we must, but we may, if we will, gather a few lessons from the past that may be of assistance in the future.

The questions have been asked, how do the railways now obtain labor, for, first, section gangs; second, extra gangs. The answer is that they obtain such labor in any way they can, and not fully recognizing the present condition of having to deal with ignorant foreign labor, few arrangements have been made, so far, to make and keep laborers satisfied and hold them. Another reason for this is that such labor is largely "floating" and no arrangements we have made will hold it for long.

It is indeed difficult to get a fair day's work out of our present track men. Even when they are willing to work hard, their ignorance and inability to understand what is said to them makes it next to impossible to get satisfactory results. Our only salvation is that we still have a few of the native stock left to lead and direct. The methods adopted to increase the amount of work accomplished will vary according to the men and conditions. There can be no rule laid down in such a matter, and I have yet to see a failure through treating men

considerately. One man may do considerable "driving" and accomplish much without losing his men or having them go "sour" on him, while another may do just the reverse. But one thing we can never afford to neglect is the square deal. Man from infancy resents injustice. It may be true that in the older countries men have been forced to accept a greater measure of injustice than do men on this continent, but even then they resented it, though unable to make their resentment felt. In this country with a choice of where and for whom they shall work, they can, and do, make their resentment effective. So that even if on no higher grounds than that of expediency, let us be fair and do justice only, in our dealings with our laborers. Not only do this personally, but see to it so far as in us lies that others do the same. The fact that many of these men will not make a fair return for fair treatment does not lessen our obligation in the matter. You owe it to yourself if not to your men, but you do owe it to them; and besides it pays, believe me, it pays well. You may not see it at once, not to-day or to-morrow, but our railways are not here for to-day or to-morrow only, and a reputation for fair treatment or dealing is a never failing source of strength to the railway company as well as to the individual. We have all seen or heard of trouble with foreign labor; do not be too hasty in condemning the men in such cases. In the light of my own experience I would accept no man's word as to where the fault lies until I had heard both sides. Our railway executives are always desirous of dealing fairly with their men, but there are many heads and hands between the executive and the man with the shovel—the contractor with his "drivers," storekeepers and timekeepers; the roadmasters with their assistants. How can our executive officers be sure that these men in excess of zeal, or greed, have not gone beyond what is fair and just? And when trouble comes it is their side of the case that is heard, and the blame put on the men.

There are several causes that lead to trouble with foreign labor. One of these is, of course, the natural foolishness of the human animal, and that is not confined to any breed or nation. The other might be shortly expressed as unfair treatment; to divide this into its several phases it would read, poor food and sleeping quarters, excessive charges for supplies, "shaving" of time, brutal treatment by foremen and indifference on the part of higher officers.

These are all dangers to be guarded against, and I want to say here that the foreigner, generally speaking, is much more responsive to fair treatment than the present day native navie. He also has more respect for authority, and is quick to note the difference between the real thing and the sham. While on railway construction work some years ago I made a special study of the Italian, and made some experiments with truly surprising results. The story is too long to set down here, but a few of the things I learned and proved were: Establish an understanding between them and yourself, and gain their confidence by being absolutely just. Feed them well, do not let them "board" themselves. Do not mix them with other nationalities in work, sleeping quarters or eating houses. Be as kind and patient as possible. Do these, and while you may have trouble even then, you will likely be surprised and pleased at the results. I was very much so indeed.

Shortly after I had become interested in this matter I had an experience that was amusing and enlightening at the same time. I had given a certain man a contract to cut and pile on the right-of-way some thousands of cords of hard wood. He could not secure good woodsmen and picked up a gang of Italians to do the work. As we required the wood for steamboat firing the roughness of the work was of no consequence, so we let him go ahead. When they had got a fair amount cut and piled I dropped off a train and measured it up for a thirty-day estimate. I did not see any of the men at this time, but it was necessary that the wood I had measured should be marked to prevent confusion, and I left a stamp hammer at the station with instructions for the section foreman to go up next morning and stamp the piles. About noon the following day I received a telegram from that foreman to the effect that he had attempted to stamp the wood, but the Italians had swarmed out of the bush and chased him two miles, and would have certainly killed him had he not been a good runner.

I wired him to meet me the next morning, and when I stepped off the train he asked me how many soldiers I had brought with me. I told him I had no soldiers, but he and I would go up and stamp the wood. He offered me the hammer and promised to pick up as many pieces of me as he could find after the gang had got through playing with me; but to go back there with one man, and him only five foot seven, he would not. He was a big Scotchman and we had considerable of an argument, but when I told him I would offer myself as a sacrifice and give him a chance to make another run, he came along.

The roadway used by the teams bringing out the wood was west of the wood piles, and the piles stretched a quarter of a mile east in the direction of the station. I took my stand on the track opposite the roadway, while Sandy got ready to either work or run, at the east end of the longest pile. I signaled him to go ahead, and the sound of the hammer on the beech wood echoed through the forest. Wow! He had not struck six blows when hell broke out for noon, back in the cutting, and out came the Italians. One fellow had a gun, some had knives, others brought their chopping axes, and one chap had a long cross-cut saw that kept catching in the brush and throwing him down, but he held onto it as his only hope. I have often listened to a pack of wolves, but that crowd could give the largest pack I ever heard cards and spades and then win in a walk. It was funny to me *because I knew,* but it was not funny to Sandy. I glanced at him, and he stood in the center of the track ready to light out for home and safety. Then the gang poured out through the opening in the fence.

But alas, what a come-down! They saw me standing there laughing at them, and recognized in me the *authority,* so instead of murder and sudden death, there were abject apologies and attempts at explanation. But I needed none. I was the one in fault; they did not understand, and I did. I had no right to send a strange man there to stamp *their* wood without explaining to them. This may not seem to have a bearing on the question we are considering, but I think it has. We must make up our minds that in future we must expect to do the greater part of our track work with foreign labor. Personally I favor the Swede and the Italian from the north of Italy. But we must do something to keep these men with us. To begin with, we should go systematically to work to secure the men we want for our sections from the better class of the people I have named, and do it now while we have a few of the native stock left to train them. Then we should help and encourage them to make homes for themselves. Keep our section force down to a reasonable number and make that number permanent. The constant change in number and personnel of our section force has a demoralizing effect. Place on the shoulders of our small permanent force the full responsibility for general maintenance, but send an extra gang over each section in the spring to put in ties and line track. If new ballast is put out have this gang attend to it also. Rush this class of work through to a finish and then lay off the extra gang.

Railway men everywhere are considering this very important matter carefully, and I am of the opinion that the plan I have tried to outline above is the real solution of the problem. We have been trying to go ahead in a catch-as-catch-can manner, conditions becoming worse each year. It is time we adopted a system and followed it. Our section forces are discouraged and demoralized. If a crew manages to get ahead with the

work they are taken off their section to help the fellow who, for some reason, is behind. We allow an extra man, or two, if we can get them, to help with the ties. Even then it takes all summer to get a reasonable number under the track, while all other work must be neglected. The small section force can no longer line the heavy track, and crews must be doubled up for that purpose. These things are all bad, and we should get away from them.

It will be claimed that these changes will cost more money than the railway can afford to pay. But we must first remember that the work must be done whether we can afford it or not. And then I am not sure that it would cost more than now. Suppose we have been in the habit of putting two men on each section of a district of twenty-five (25) sections to help out during April, May, June and July, and it takes the crews so strengthened all of this time to get in the ties, and then they cannot line or do any other work. Now make up two extra gangs of twenty-five (25) men to do nothing but put in ties and line. Would not they do the whole district in less than four months while all other work should be kept up-to-date by the regular section crew, who would neither be increased in the spring nor decreased in the fall?

We must secure permanence and contentment in our section force. It is not good policy to reward a man and crew for extra effort by taking him off his section to help some other fellow.

HIGHER WAGES FOR PERMANENT LABOR.

J. H. C., Roadmaster.

This season is the worst I have seen in years, and labor is very scarce. The laborers are not as good a class as in former years. The cost of living, even for foreigners, is higher and the better class of this labor is taking to other work that pays better wages. The only way and solution for railroads is for all to adopt a standard wage for track labor, a wage high enough so the laborers can live well and support their families. Such wages are not paid at present. Some roads pay more than others for the same kind of work which is just as hard on one as on another. I find making headquarters, camps, and places to live in as pleasant as possible is one strong attraction which helps to hold our men, for when they once get located, are contented, and are used as working men should be they stay, no matter how hard they work. Good men, when abused, will not stay long.

We pick up our own men, in large gangs, by having the men look around for men of their class. We do not employ labor agents. Our section men are usually located near headquarters and usually stay. A good many have homes. Some are boys from the farm and they make good men. Better wages would attract more intelligent men and better laborers. This is advisable, at least for men that we employ steady the year around. These should get more than the extra men. This system would give some inducement for extra men to work for regular jobs, especially if steady men were picked out for foremen.

I am in favor of apprentice foremen, picking out the native laborers from the ranks, putting them on sections with good experienced foremen, with good wages. Then there will be no trouble in making foremen.

MOTOR CARS AND LARGER SECTIONS.

H. D. Cramblit.

The labor question is certainly the most perplexing problem that the track department of any railway has to deal with. While the wages usually paid track labor are not quite as much as they should be, I believe longer sections and bigger section crews will go a long way toward solving the labor question.

And I wish to add right here that the old-time hand car should be thrown in the junk pile. It is useless to try to keep men on the section nowadays when they have to do the hardest part of the day's work getting home.

Here are some things, I think, that will help wonderfully in keeping men on the section: First, a good, sensible foreman that will treat his men right; second, a good gasoline car and track enough to warrant the employment of 8 or 10 men in summer and 2 or 3 in winter. Men are more apt to follow section work if they can work together enough to make the work easier and more interesting for all. Then if American labor cannot be had, it is always easier to get 10 foreigners than it is to get 2 or 3, for this class of laborers does not like to work 2 or 3 in a place.

I think the most important thing is a good foreman. Too many of the section foremen we have today are descendants of steamboat captains of the brave old days, when our native profanity was at its best. It is a real treat to see one of the old time foremen trying to do a piece of work with a bunch of green men. He brings all the cuss words ever thought of into play. Now I do not consider this the proper way to teach a man to do his work. Besides it is all nonsense, and these men, once they have worked for a foreman of this kind, will hardly ever work for him the second time.

I believe foreign labor is better than American labor for section work for this reason: They are more steady, hardly ever want to lay off, and if handled properly will do just as much work with less complaining than the average American will.

And here again I wish to bring in the all-important point of properly handling men, either foreigners or Americans. Never under any circumstances let the men think that they are working for a rich corporation. Make them understand that they are working for you personally. This may seem like a hard proposition, but it is not if you start right.

FAMILIARITY WITH YOUR WORK AND MEN.

J. J. Hess, Roadmaster.

Wherever local labor can be procured it is preferable to do so, but where country is sparsely settled it has to be obtained through labor agencies. This company has a labor bureau established for the latter purpose. Extra gangs are practically all secured from that source. We aim to treat all laborers in such a way as to keep them satisfied; that is, to see that they are well quartered and avoid exacting anything unreasonable. We also strive to select foremen who exercise good judgment in handling men and possess sufficient patience to show and tell them how to do their work, rather than to expect them to know; for if a man shows a willingness he is more preferable than the ones who know and yet are unwilling to perform duties assigned them.

I have always thought that there is a chance for a broader display of judgment in the track department than in any other, inasmuch that the duties cannot be outlined the same as in any other department—hence one has to be resourceful and act according to whatever emergencies arise, which as everyone knows, are many, and these are in addition to ones regular assigned duties. It is generally understood that any department is at liberty to call on track men in time of need, and be it said in their behalf the writer has yet to hear of the first time any of them failed to respond to call, regardless of whatever climatic or other conditions existed; and while it will no doubt be observed from the tone of this communication, that I am favorably inclined and somewhat partial to that department, yet I have no apologies to offer for so being.

The laborers we get make good track men wherever we are fortunate enough to get good foremen, in other words, show me a good foreman and I will show you a good gang.

The writer's idea of handling men is to treat all as I myself would like to be treated. Occasionally one finds an exception that is inclined to take advantage of such treatment, but it is always an easy task to weed out people of such a nature. Some foremen are too severe, overbearing and exacting; also incompetent to the extent that they themselves retard the work through faults of their own in not assisting their men and taking up so much time with their part of the work.

Workmen become discouraged thereby, as they possess sufficient pride to desire to see results of their labor.

Everyone should strive to be fair in his dealings with men, get their good will and neither receive or extend any favors.

The writer contends that every one handling or having to do with men in any capacity should strive to get well acquainted with them and handle them according to their disposition and nature. One or two words of a reprimand with many answers the purpose the same as taking others severely to task. It is always well to strive to keep men in good humor and in a cheerful mood and appeal to the pride which all of the human family possess; at any rate, all who are willing to work and earn an honest living.

I have never experienced any difficulty in obtaining satisfactory results. In cases of emergency where necessary to employ extra efforts on the part of the men, I have always urged them to do all that is possible, explaining the object and circumstances and always use the expression "come on" instead of "go on," as I have experienced that men will be led but resist being driven. I always acquaint men under my supervision with my idea of handling men. If they decline to work and act in accordance therewith, they are requested to seek employment elsewhere; while it is true that it is somewhat trying and humiliating to let men have their own way to a certain extent, yet I feel that the end jusifies the means and that there are times when one has to bear and contend with things not to his liking. It is far better to hang on to men, even though they are not quite so good as one wishes, rather than to be without, until conditions become improved.

I have had some foremen drive off their men, the method in their madness being to offer as an excuse when asked to do anything, that they have no men. Such are the men it behooves all to keep their interests out of the hands of. I have never experienced any trouble getting competent foremen, notwithstanding I have been in the most sparsely settled parts of the country. The methods employed are to get well acquainted with all the workmen, and get out frequently on the work with them; note all that take hold and interest themselves in their work; inquire of foreman as to their habits; tell him to give the ones that attract special attention an opportunity to familiarize themselves with foreman's duties; compliment the ones in question for interest taken and energy displayed, and tell them what the prospects are for advancement in case they learn and are recommended by the foreman. This offers an incentive to the other workmen and gives the foreman more prestige and a better standing, showing that his superior officer has confidence in him to the extent that by rendering satisfactory service and satisfying their foreman, laborers can be advanced through his recommendations.

A good deal of difficulty is encountered by many in authority because of not being competent to judge a good workman and failing to get close enough in touch with their work or men. No one is competent, after sufficient time has elapsed to get acquainted with his men, who is unable to keep his ranks filled with men under his own supervision.

There is too much being tried and expected by long range and on paper. I don't favor going over roads on rear of passenger trains; neither are motor cars a good thing, except for special purposes. My idea is to go over the line with section gangs; stop wherever necessary, discuss and decide upon best methods to employ in doing work; exchange ideas and demonstrate, if need be, how various classes of work are desired. Inspect all company buildings and see that gangs are properly supplied with tools. By so doing, you show that an interest is being taken. In absence thereof the foreman is not to blame for feeling that if his superior is satisfied, he ought to be. It is difficult and unreasonable to expect others to become interested unless it is shown we are likewise. It is not the one that is furnished with everything to do with that is deserving of credit and recognition, so much as the one who reaches out and is resourceful enough to do the best he can with what he has to do with.

HEAVY DEMAND ON THE TRACK FORCES.

W. K. Walker, Division Engineer.

One of the foremost problems confronting superintendents, division engineers and roadmasters in charge of track maintenance today, is the securing and keeping of laborers on extra and section gangs.

The inducements offered laborers are different at the various seasons of the year. During the winter time when all kind of work is slack, it is an easy matter to keep extra gangs filled with foreign labor; sections with either foreign or native labor. Of course in a sparsely settled prairie country there are points where native labor is not obtainable at any season of the year. At such points it is necessary to work foreign labor wholly, and for such labor it is necessary to provide living accommodations. In the winter time when work is scarce, we make a practice of making a cut in wages, usually to $1.25 or $1.35 per ten hour day. At this rate of pay, laborers for both extra and section gangs are plentiful. In the spring when other kind of work begins to open up and railroad work also assumes an active trend, we find that to increase our gangs, or even to hold the men we have on sections and extra gangs at the winter rate of pay, is an impossibility. Therefore we are compelled to come to summer basis of rate of pay. This rate usually is $1.50—$1.60 to $1.75 per day for laborers on both section and extra gangs.

Other inducements besides pay also have to be offered laborers. With native laborers, the promise of a steady job to some; promotions to the position of foremen to take the place of section foremen; promotions to foremen of extra gangs or to the position of time-keepers on extra gangs. This helps to keep native labor during the forepart of the summer months.

With the foreigner, he is up in arms, demanding in addition to the increase in pay, better cars and on extra gangs a car to each eight men. Extra gangs demand an interpreter, who usually rules the entire gang; also one or two water boys at the same rate of pay as the remainder of the gang. If they don't like the foreman they don't stand back on asking for his removal. All these things a roadmaster has to fight in his own way in order to maintain proper control of his men.

Here in Southeastern Kansas, our winters ordinarily are not severe. The cold weather we do have is for a very short period; therefore, a fair force is maintained on sections and a few extra gangs are kept working during the entire winter. Three-fourths of the sections work native labor, while one-fourth of the sections and all extra gangs work foreign labor during these winter months. The sections working native labor do not require any special in-

ducement to hold the men during winter. For the foreign labor on sections we are required to furnish living quarters, usually dismantled box cars, ceiled inside with windows and doors cut in same. Extra gang laborers are provided with comfortable bunk cars with one stove in each car. The railroad company also furnishes fuel for the men. For foreign labor we work the Mexican almost exclusively during the winter months. In order to hold these men at any time of year it is necessary that we procure provisions for them. They never save a cent; therefore we usually issue, through the foremen, board bill orders on some merchant in the town which they are working. The merchant then receives his pay for the provisions furnished, on the regular railroad company pay roll. As long as we provide living quarters and provisions for the Mexican laborer, winter or summer, he is contented.

During the summer time conditions are different. Our sections drop down to about two-fifths native labor and three-fifths foreign; all extra gangs foreign. We always endeavor to fill our sections with Mexicans, using Greeks, Italians and Mexicans on extra gangs. It is with the Greek and Italian labor that we experience the most trouble. These are the laborers that demand so much of a roadmaster. The Mexican is easy to rule and as long as he is fed he does not complain.

I find that best results can be obtained from all foreign labor by kindness, yet being firm and seeing that they obey your instructions. The negro laborer is the only one I have had experience with where I found it best to drive him with a club, and I do not think that this is necessary in the majority of cases. Kindness and firmness are the two principal attributes of a good extra gang foreman.

On sections I find the motor car is a great drawing card to hold laborers, both native and foreign. I never have the trouble holding good foremen or laborers on sections on which motor cars are used. The men on these sections claim their work is only half as hard as is the section on which hand cars are used. Out of sixty-five sections, I have twelve equipped with motor cars and on these twelve, with the same force as the other sections of like conditions, I can easily note a far better class of track maintenance. The motor car in my opinion is the one foremost solution of the labor question as well as of the economical maintenance of track.

The position is often taken that the foreman and laborer of today are inferior to those of 15 or 20 years ago. This I doubt very much. The trouble is we are demanding so much more of our men. Our foreman to be termed a "good man" must be a clerk, claim agent, civil engineer, carpenter and track foreman. Duties in all these lines are thrown on him. Fifteen or twenty years ago it wasn't so. Then his duties were to merely maintain the line and surface of his track. Then he had light power—now the foreman has the heaviest power useable on his track—trains running on as high speed as ninety miles per hour.

For such power and speed he is compelled to maintain his track in line and surface 50 per cent better than it was fifteen or twenty years ago. After working hard all day on his track, he goes home at night and after supper starts out to find some party, one to two miles away, who had a cow killed or pasture burned recently. This is the claim agent for you.

The next day he goes home tired from a hard day's work, still he is compelled to stay up late making out reports, answering correspondence, etc. Here is the expert clerk.

On the track all next day, he raises track, lines it to centers, lines spiral curves, uses his own judgment about building of a dump for a new track, puts in the switch from details received by mail. Here is the work of Mr. Civil Engineer combined with that of Mr. Section Foreman. All this for the same pay the foreman of fifteen or twenty years ago was getting for doing only track work. Think of all this, and is it any wonder we have a hard time keeping native young men on our sections to promote to the important position of foremen?

The laborer is up against just as hard a proposition as the foreman. The foreman today demands more of his men than did the foreman of years gone by. The rate of pay for all other classes of labor has raised from year to year until the track laborer pay is a mere shadow to that of his brother laborer who is engaged in some other class of work.

What inducement can we offer to overcome this great difference? The answer seems to stare railroads in the face thus—raise track labor pay, and provide tools that will lessen the work. Then and not until then will the native labor come to your door begging to be let in. With all of this now before railroad maintenance officials the question is—how do you now cope with these conditions? Answering for my own methods, will say, that as before stated, wages are raised in the early spring. To secure labor I usually start early and get my pick of the Mexicans who wintered in large towns on the division. Later on when labor gets more scarce, I apply to labor agencies who have a line up on labor at other points. Through the labor agencies I can usually keep my gangs going. A Mexican gang once fully organized is easy to keep going full handed. Once organized on both section and extra gangs, the problem is—get a day's work out of every man. I usually manage this by using only small gangs. Ordinary section gangs never to exceed six men, yard gangs, twelve men, having a foreman and one assistant foreman in charge. The assistant foreman, when with the foreman, works the same as the other laborers. Extra gangs range from fifteen to forty-six men, according to the class of work being performed. All gangs of over thirty men have an assistant foreman in addition to the regular foreman. In all work on track by both section and extra gangs I try to instill into my foremen the idea of thoroughness. In all work on track, the completeness or thoroughness of doing each job while you are working on it stands first in importance. A job once well done and completed while at it, costs a great deal less and will hold a great deal longer than one only half done. The foreman who is a neat worker and always digs away on one job at a time and completes that one before leaving it, stands foremost among his fellow workers. Where is the official who on inspection will fail to appreciate track work neatly and completely done?

Thus we stand today trying every conceivable idea to do better work with the means at hand. I once heard a definition of a civil engineer given as—"A person who could do something with nothing." Today it is not only the engineer who is up against a like proposition, but so is every officer who is handling maintenance of track. The man who makes good must have the ingenuity to handle his men so as to get a day's work out of them and still have them feel they are having an easy time. By so handling your men you can hold a limited number the year round. With all this granted for the present, we must admit that railroads are facing a problem in track labor which must be met soon by both increased wages and improved tools to lessen work.

In the same line of labor conditions, the proposition of future section foremen is a hard one to solve. I am pursuing a course that is proving very satisfactory now, but how long it will last, I am afraid to guess. On each road-

master's territory I keep two young men who are called apprentice foremen. These men are given the opportunity to learn all the "ins and outs" of section work. They are promoted from track sections to yard sections, are placed as assistant foremen on extra gangs, given opportunity to learn reports, etc. Roadmasters take special interest in schooling these men. When they reach a certain degree of competency they are given a position as section foremen when a vacancy occurs. Then some other bright young man is given the vacancy as track apprentice. This method, I find, tends to keep some few young native men on sections as laborers.

A great assistance in holding foreign labor on extra gangs is giving careful consideration to the ability of the different nationalites to the work they can best do.

Close supervision and a careful study of the requirements of the men under his jurisdiction greatly assists a roadmaster in holding laborers at all times of the year.

An issue of bonds for the Pacific Great Eastern has been guaranteed by the British Columbia government. This line is to be built from Vancouver, B. C., north to the Grand Trunk Pacific at Prince George, about 350 miles, and the company expects to have all the work finished within two years.

There are prospects that the St. Louis & St. Libory project may be revived and the road completed. A considerable amount of grading work on this line was done several years ago. It is now reported that Attorney M. W. Borders, 209 S. La Salle street, Chicago, Ill., who is associated with other Chicago parties in the ownership of thousands of acres of coal land along the projected route, has obtained an option on the right of way so far purchased for the railroad, and if he is successful in his plans he will build the proposed line.

The Pennsylvania & Southwestern has been incorporated in Pennsylvania to build through Bradford, Tioga and Lycoming counties. It is said that the New York Central interests are back of the project.

Surveys are underway for securing an outlet from Macomb for the proposed St. Louis, Macomb & Northern, of which E. L. Tobie, Macomb, is the promoter.

The Wabash Railroad plans to make improvements as follows: Laying second track between Romulus, Mich., and Britton, on the Detroit division, cost $500,000; additional yard and terminal facilities at Detroit, cost, $400,000; new locomotive shops at Decatur, Ill., cost $500,000; and new water tanks and coaling stations to cost $130,000.

The Provo & Eastern Utah has been incorporated in Utah with $10,000,000 capital, to build from Springville, Utah, east to Jensen, about 120 miles; the line is later to be extended east to Steamboat Springs, Colo., the present terminus of the Denver, Northwestern & Pacific.

LIFE OF TIES IN EXPERIMENTAL TRACK, G. C. & S. F. RY.

An inspection of experimental track on the Beaumont division, G. C. & S. F., was made June 6, 1912. The following men were in the inspection party: Dr. H. Von Schrenk, superintendent timber preservation, Rock Island Lines; George E. Rex, manager treating plants, A. T. & S. F.; R. S. Belcher, chemist, Texas Tie and Lumber Preserving Co.; A. L. Koonee, roadmaster, G. C. & S. F.

A record of previous inspections, together with the results of the inspection mentioned, is given in the table below.

Ties listed in the column marked "Decay" are such ties as show signs of decay to some extent. Some of these ties will come out of the track this year, but many of them are still good for one or more years of service.

General condition of ties now in the track may be stated as good. There is very little rail wear except in the case of hemlock ties. The apparent rail-cutting evident on many ties is due to adzing necessary on account of changing the rail. The hemlock ties, although marked sound, in many instances show signs of severe checking and shattering.

Ties treated with Bakersfield crude petroleum, some of which have been in service since 1902, show remarkable state of preservation. It is particularly noticeable that none of these ties show even the slightest checks.

Rail wear on the ties treated with zinc chloride, followed by subsequent treatment of Bakersfield oil, was very marked, while in those ties treated with Bakersfield oil alone, the rail wear is practically insignificant.

We are indebted for the information herein given to Mr. George E. Rex, manager of treating plants, A. T. & S. F. Ry.

Kind of Wood	No. of Ties	Kind of Treatment	Year Inserted	Ties Removed to June 1904		Nov. 1905		Dec. 1906		Feb. 1908		Nov. 1908		Sept. 1909		Feb. 1911		June 1912		Ties Still in Track Number Good	Decay	Per Cent
				No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
Pine	19	Diamond Glue Private	Feb. 02			17	89.5			2	100									0	0	0
"	74	Barschall	"			33	44.6	37	94.6					1	95.9	1	97.3			2	0	2.7
Calif. Redwood	8	Burnett	"			8	100													0	0	0
" "	2	Burnett Cal. Crude Oil	"			2	100													0	0	0
Longleaf Pine	4	Burnett	"					2	50	1	75											
Shortleaf Pine	3	"	"					2	66											1	0	33
New Mexico Pine	10	"	"					2	20											3	0	30
Gum	3	"	"													1	33			2	0	67
Water Oak	2	"	"																	2	0	100
Pin Oak	2	"	"							1	50											
Red Oak	2	"	"					1	50													
Longleaf Pine	6	Boiled in Zinc-Chloride	"															1	17	5	0	83
Shortleaf Pine	4	" "	"							1	25									3	0	75
Arizona Pine	2	" "	"																	2	0	100
Shortleaf Pine	* 4	Bakersfield Oil	"					1	25											3	0	75
Loblolly Pine	4	" "	"																	4	0	100
Arizona Pine	2	" "	"																	1	0	50
New Mexico Pine	* 3	" "	"					2	66											1	0	33
Gum	1	" "	"																	1	0	100
New Mexico Pine	8	Burnett - Cal. Oil	"																	8	0	100
Loblolly Pine	1	" " "	"																	1	0	100

* The three Bakersfield Crude Oil Ties were removed in 1906 for inspection and were in a perfect state of Preservation.

Record of Life of Topeka Ties in Experimental Track on the Beaumont Division G. C. & S. F. Ry.

Kind of Wood	No. of Ties	Kind of Treatment	Date Inserted	Ties Removed To																		Ties Still in Track		
				Nov. 1903		June 1904		Nov. 1905		Dec. 1906		Feb. 1908		Nov. 1908		Sept. 1909		Feb. 1911		June 1912		Number		Per Cent
				No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	Good	Decay	
White Oak	196	Untreated	May '02			1	0.5					146	75							19	85	13	17	15
"	100	Burnett - Chicago	"															64	64			27	9	36
"	101	Wellhouse - Chicago	"									3	3	2	5					2	7	64	29	93
"	107	Zinc - Creo. Beaumont	"	45	42	36	75.7	26	100													0	0	0
"	100	Burnett A&L Smvlle	"									17	17	1	18	82	100					0	0	0
"	100	Wellhouse A&L. Smvlle	"											42	42					6	48	24	28	52
"	100	Allardyce A&L. Smvlle	"											1	1	1	2	69	71			22	7	29
"	196	Barschall A&L. Smvlle	"					2	1	22	12.2	140	83.7							2	85	18	12	15
Red Oak	93	Untreated	Mch '02			5	5.4	77	88.2					5	93.5			6	100			0	0	0
"	86	Burnett - Chicago	"													3	3.5	21	28	9	38.4	21	32	61.6
"	20	Burnett A&L Smvlle	"													20	100					0	0	0
"	20	Wellhouse A&L. Smvlle	"													20	100					0	0	0
"	10	Allardyce A&L. Smvlle	"																			6	4	100
"	19	Barschall A&L. Smvlle	"					15	78.9	2	89.5			2	100							0	0	0
Black Oak	24	Untreated	May '02					3	12.5	19	91.7	2	100									0	0	0
"	86	Wellhouse → Chicago	"									12	14	2	16.3			10	28	48	84	6	8	14
"	76	Zinc - Creo. - Beaumont	"	36	47.4	40	100															0	0	0
"	34	Burnett A&L. Smvlle	"									5	14.7					29	100			0	0	0
"	33	Wellhouse A&L. Smvlle	"									2	6	16	54.7			11	88	4	100	0	0	0
"	60	Allardyce A&L. Smvlle	"															46	77			14	0	23
"	118	Barschall A&L. Smvlle	"					104	88.1	4	91.5	3	94.1	7	100							0	0	0
Turkey Oak	20	Untreated	Apr. '02							18	90	2	100									0	0	0
"	10	Zinc - Creo - Beaumont	"					10	100													0	0	0
"	19	Burnett A&L. Smvlle	"													19	100					0	0	0
"	20	Wellhouse A&L. Smvlle	"													18	90					0	2	10
"	10	Allardyce A&L. Smvlle	"																	1	10	7	2	90
"	19	Barschall A&L. Smvlle	"					18	94.7	1	100											0	0	0
Spanish Oak	20	Untreated	May '02					4	20			16	100									0	0	0
"	10	Zinc - Creo. - Beaumont	"					8	80													2	0	20
"	21	Burnett A&L. - Smvlle	"															4	43	12	78			
"	20	Wellhouse A&L. - Smvlle	"															9	45	4	65	5	2	35
"	10	Allardyce A&L. - Smvlle	"															5	50			5	0	50
"	20	Barschall A&L. - Smvlle	"					1	5	8	45	11	100									0	0	0
Willow Oak	20	Untreated	May '02					15	75	5	100											0	0	0
"	11	Zinc - Creo. - Beaumont	"					11	100													0	0	0
"	20	Burnett A&L. - Smvlle	"													20	100					0	0	0
"	20	Wellhouse A&L. - Smvlle	"											8	40			12	100			0	0	0
"	10	Allardyce A&L. - Smvlle	"															10	100			0	0	0
"	20	Barschall A&L. - Smvlle	"					17	85	3	100											0	0	0
Beech	100	Untreated	Feb. '02					97	97	3	100											0	0	0
"	50	Zinc - Creo. - Beaumont	"									50	100									0	0	0
"	99	Burnett A&L. Chicago	"															75	76			14	10	24
"	100	Wellhouse A&L. Chicago	"																	30	30	44	26	70
"	50	Allardyce A&L. Smvlle	"															40	80			10	0	20
"	98	Barschall A&L. Smvlle	"			2	2	96	100													0	0	0
Hemlock	101	Untreated	Apr. '02			101	100															0	0	0
"	49	Zinc - Creo. - Beaumont	"							38	77.6			4	85.7			1	88			5	1	12
"	100	Burnett - Chicago	"											30	30					35	65	18	17	35
"	100	Wellhouse - Chicago	"													4	4							
"	50	Allardyce A&L. Smvlle	"															50	100			0	0	0
"	100	Barschall A&L. Smvlle	"					87	87	7	94			6	100							0	0	0
Tamarack	49	Untreated	May '02					49	100													0	0	0
"	51	Zinc - Creo. - Beaumont	"													46	90.2					5	0	9.8
"	49	Burnett - Chicago	"																	49	100	0	0	0
"	100	Wellhouse - Chicago	"																	100	100	0	0	0
"	50	Allardyce A&L. Smvlle	"															50	100			0	0	0
"	98	Barschall A&L. Smvlle	"					78	79.6			11	90.8					9	100			0	0	0
Shortleaf Pine	100	Untreated	May '02			35	35	20	55	44	99							1	100			0	0	0
"	50	Zinc - Creo - Beaumont	"											42	84							3	5	14
"	100	Burnett A&L. Smvlle	"											61	61			1	62	5	67	22	11	33
"	100	Wellhouse A&L. Smvlle	"											79	79					1	80	10	10	20
"	50	Allardyce A&L. Smvlle	"											21	42	1	44			20	84	7	1	16
"	98	Barschall A&L. Smvlle	"							74	75.5			23	99							0	1	1
Longleaf Pine	93	Untreated	Apr. '02					85	91.4					1	92.5			7	100			0	0	0
"	50	Zinc - Creo. - Beaumont	"									19	38	1	40					4	48	17	9	52
"	100	Burnett A&L. Smvlle	"									27	27							6	33	50	17	67
"	100	Wellhouse A&L. Smvlle	"									3	3	52	55							26	19	45
"	100	Barschall A&L. Smvlle	"									95	95									3	2	5
"	150	Allardyce A&L. Smvlle	"									7	14							9	32	31	3	68
"	100	Beaumont Oil Smvlle	"							70	70							30	100			0	0	0
"	100	Bmt Oil-Zinc Chloride	"															8	8			56	36	92
"	100	Spiritine A&L	"							8	8	72	80					5	85			9	6	15
Loblolly Pine	100	Untreated	"			100	100															0	0	0
" a	49	Zinc - Creo. - Beaumont	"															49	100			0	0	0
" d	99	Burnett A&L Smvlle	"															99	100			0	0	0
" c	99	Wellhouse A&L Smvlle	"															94	95			0	5	5
" b	49	Allardyce A&L Smvlle	"															49	100			0	0	0
"	99	Barschall A&L Smvlle	"					18	18.2	81	100											0	0	0
"	42	Beaumont Oil Smvlle	"					40	95.2									2	100			0	0	0
"	80	Bmt. Oil-Zinc Chloride	"															80	100			0	0	0
"	100	Spiritine A&L. Smvlle	"					80	80	18	98							2	100			0	0	0
Pines	84	Avenarius Carbolineum	Apr. '05							1	1.2	74	91.7											

Remarks:- Longleaf and Loblolly soaked with Beaumont Oil absorbed 3 lbs. per cubic foot

a - Original quantity 50, one out for test
b " " 50. " " " "
c " " 100. " " " "
d " " 100. " " " "

Zinc - Creosoted Ties. Beaumont oversteamed

Mr Chanute's Ties treated - Chicago.
Ayer & Lord — Somerville
International Creosote Co. — Beaumont
Hasselman or Barschall by Ayer & Lord Co. Somerville.

Record of Life of Ties in Experimental Track on the Beaumont Division G. C. & S. F. Ry.

With The Manufacturers

PORTABLE POWER DRILL.

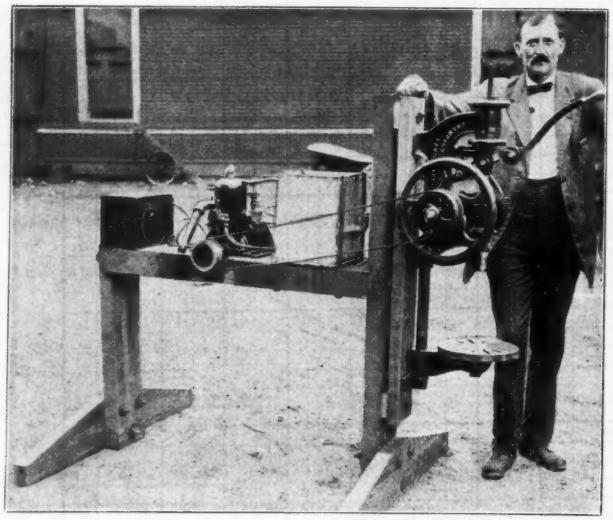
In line with the editorial headed "Substitution of Power for Hand Labor," on page 311 of the July issue of *Railway Engineering and Maintenance of Way*, J. F. Williams, supervisor of signals of the Cleveland, Cincinnati, Chicago & St. Louis Ry., at Springfield, Ohio, furnishes a photograph, reproduced herewith, of a portable power drilling outfit. This outfit, as will be noted, consists of a small gasoline engine, belted to a Champion drill press. The engine used is a "Belle Isle Motor" made by the Concrete Form & Engine Co., Detroit, Mich. It is of 2½ horse power and is particularly well adapted to such purposes as this.

In commenting on this outfit W. D. Waugh, of the Concrete Form & Engine Co., writes as follows:

"We are prepared to furnish a portable power drill equipment similar to that shown in the photograph, at a cost of $130. The equipment which we will furnish, however, will be slightly different and will be made more convenient. For instance, the battery box would be put underneath the table, probably building another shelf which would hold wrenches, tools, etc. I believe it would be well to furnish a small vise, probably 3½ inch jaw, which could be secured at a probable cost of $3.50. This vise when bolted to the face plate would be found a great convenience for holding small pieces. A belt shifter would be carried through to the right hand side of the drill press and the electric switch would be taken from the battery box to a point within easy reach of the operator.

"In a recent letter, Mr. Williams states that this power drill will more than pay for itself on one job of interlocking in the saving of labor. The ordinary hand drill press requires two men all of the time. With this new power drill, it will require only one man and he will do at least one-third more than two men would by hand. This will allow the other man to be doing other work, or possibly the gang can get along with one man less.

"I might further state that on a recent test, the engine running at normal speed, one man drilled a ½ inch hole in a switch bar, in a few minutes. When not in use on the road, this same equipment would be found very valuable in any division yards, for operating light machinery."



Portable Gasoline Drilling Outfit.

New Literature

The Hayes Track Appliance Co. of Richmond, Ind., has issued Bulletin No. 71, which shows a new line of switch stands for use with Hayes derails. These stands are very low, and lighter than an ordinary stand, because the strain imposed when operating the derail is very small, and parts can be made much lighter than on an ordinary switch stand. The claims put forth for these stands are simplicity (no gears), durability (parts of ample size and best material), and low cost (about one-half the cost of an ordinary stand). The target stand illustrated is for the purpose of showing the location and operating position of the derail. This stand requires only one long tie, and this, together with the low cost of the stand, makes the installation a very economical one.

* * * *

The Titanium Alloy Mfg. Co. has issued a booklet describing some recent rail tests on the Delaware & Hudson. The test was carried out with titanium open hearth and plain open hearth rails. The amount of titanium used was 0.1 per cent, and the installations were all on curves. The inspection and report was prepared by Robert W. Hunt & Co., and showed the following results: Ratio of wear of titanium rails to open hearth rails, high side of curve, 1 to 1.48; low side of curve, 1 to 1.37; average, 1 to 1.44. The average in favor of titanium was 44 per cent.

Fig. 1—Ware Tie Plate Gauge and Tie Surfacer.

Fig. 2.

WARE TIE PLATE GAUGE AND TIE SURFACER.

In the illustrations herewith is shown a new device recently invented and patented by Mr. Henry Ware, of Springville, N. Y., retired roadmaster of the Buffalo, Rochester & Pittsburgh. The object of this device, which is known as the Ware Improved Tie Plate Gauge and Tie Surfacer, is to aid the track man in the proper adzing of ties, whether in the track or out, to assure a perfect rail or tie plate seat; and also to properly adjust and gauge tie plates to ties in the track or out, so that the shoulder of the tie plate or spikes will come in full contact with the base of the rail. Tie plates thus properly applied prevent the possibility of ties being put in the track and spiked other than at right angles with the rail.

The device, as shown in Fig. 1, consists of two flat surface plates of proper dimensions, made in the form shown in Fig. 2, so that two squares are provided and adjusted, in which tie plates can be placed for embedding at proper gauge. The two plates are connected with an iron pipe, one plate being permanently fastened and the other made adjustable by means of a split sleeve socket gripped together to hold it at any required gauge. A hole is provided at the top of the sleeve in which a quarter-inch bolt is inserted to enter a slot that is made in the pipe, to hold the two surface plates in the same plane.

The adjustable end shown in Fig. 1 is interchangeable with the adjustable end shown in Fig. 3. By the use of the end shown in Fig. 3 a means is provided by which the rail seat at one end of the tie is made by working from the top of the rail at the other end. This is accomplished by means of the vertical bar in this head which adjusts the device to meet the different height of rails, so that the adzing can be done to conform to the plane of the rail seat on which the fork end of the tool is resting.

The tool in its original form has been used extensively on a number of roads, but the inventor, sharing in the opinion of many close observers, realized that the improper seating of the present heavy tie plates had much to do with the breaking of rail bases on tie plates. These breakages have been very prevalent in recent years, and for that reason the device shown was put on the market so the adzing of ties can be more perfectly done to assure a proper rail or tie plate seat.

Fig. 3.

Fig. 4.

Figure 1 shows the need of adzing ties at rail seats.

Fig. 2 shows the rail seats, brought into the same plane, and device adjusted for gauging plates in ties in track.

Figure 3 shows tool as applied to adzing ties in connection with relaying rail, with one rail moved out.

Figure 4 shows tool applied to tie that has been adzed in the manner indicated in Fig. 3, which shows that both rail seats have been brought into the same plane.

Figure 5 shows the device adjusted for gauging plates in track with one rail moved out.

Figure 6 shows the tool adjusted for adzing ties to cant the rail in.

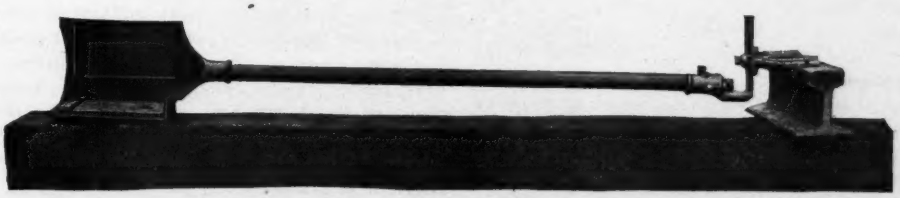


Fig. 5.

Fig. 6.

TRACK SUPPLY ASSOCIATION.

The Track Supply Association will hold its annual exhibit at the convention of the Roadmasters and Maintenance of Way Association, in Hotel Statler, Buffalo, N. Y. A diagram is shown herewith, giving the location and the numbers of the booths. The booths will be occupied by the firms shown below.

Ramapo Iron Works 1
Pennsylvania Steel Co. 2
Vaughn Rail Support Co. 3
Lackawanna Steel Co. 4
The P. & M. Co. 5
Elliott Frog and Switch Co. 6
Fairbanks, Morse & Co. 7
Ajax Forge Co. 8

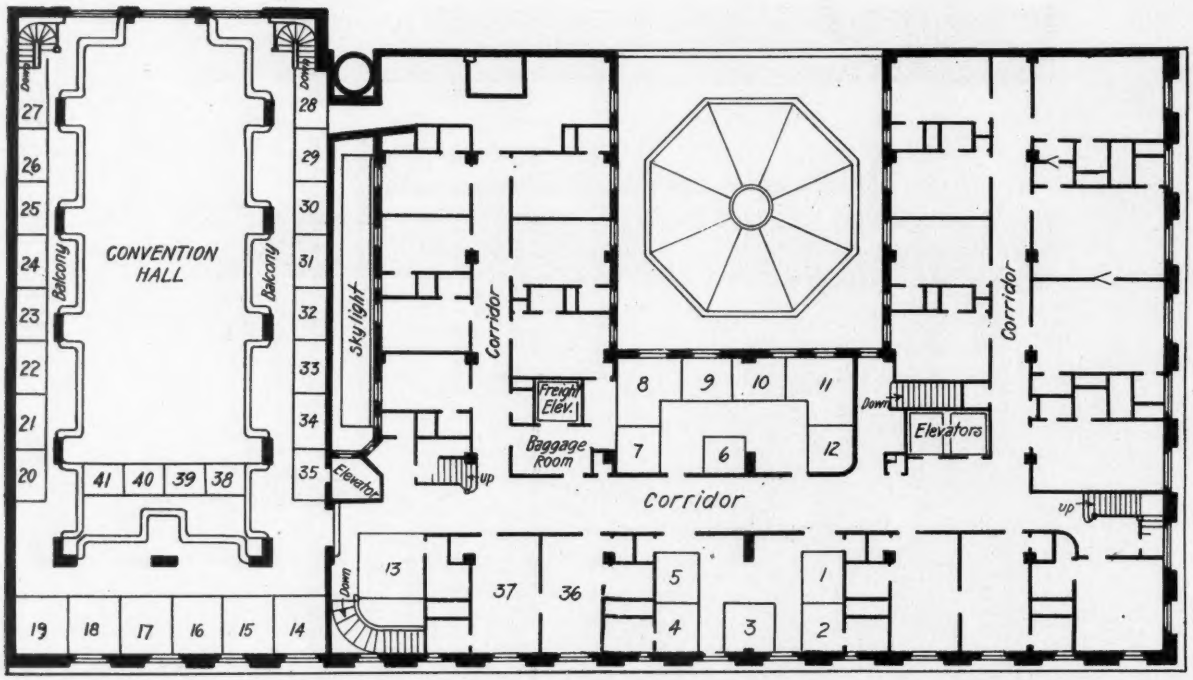


Diagram of Exhibits at the Roadmasters' and Maintenance of Way Association, Hotel Statler, Buffalo, N. Y.

Q. & C. Co. 9
Railroad Supply Co. 10
National Lock Washer Co. 11
Templeton, Kenly & Co. 12
Chicago Pneumatic Tool Co. 13
Carnegie Steel Co. 14
Rail Joint Co. 15
Hayes Track Appliance Co. 16
Sellers Mfg. Co. 17
American Valve & Meter Co. 18
National Malleable Castings Co. 19
Joyce-Cridland Co. 20
American Guard Rail Fastener 21
M. W. Supply Co. 22
Indianapolis Frog & Switch Co. 23
Buffalo Forge Co. ..... 30 and 31
Chicago Steel Railway Tie Co. 32
Alex. Milburn Co. 33
Pratt & Letchworth Co. 34
Verona Tool Works 35
Southern Railway Supply Co. 36
American Hoist & Derrick Co. 37
Railway List Co. 38
Railway Engineering & Maintenance of Way 38

A number of additional firms have promised to exhibit, but the list given above covers all those who have definitely accepted at this date.

Articles of incorporation have been filed with the County Recorder, Peoria, Ill., by the Eldred Development Co., capitalized at $60,000, and proposing the construction of bridges, tracks, houses, etc. O. G. Leach, C. C. Orange and R. D. Clark are incorporators, and the headquarters of the company are at Peoria, Ill.

The A. T. & S. F. has decided upon the expenditure of about $57,000 for the construction of a new depot at Harper, Kan., and also for the extension of the yard facilities.

Bids will be received, it is reported, by the Georgian Coast & Piedmont, for the construction of 13 66-ft. deck girder approaches.

The Canadian Northern's improvements in the vicinity of Toronto, will amount to many millions of dollars. They will include the new yards and shops at Leaside Junction, a handsome 12-story office building in Toronto to house the head offices of the company, the new Yonge Street station, and the North End viaduct. Besides these works the company will have large yards and shops at Port Mann, British Columbia; smaller shops and yards on the Rideau River, near Ottawa.

The chief shops of the new transcontinental line will be those at Leaside and at Port Mann. Sir William Mackenzie stated that he was now considering the plans for an office building.

The Memphis, Columbus & Gulf has plans calling for one river bridge, several trestles and stations at six cities. G. T. Heard, Brookville, Miss., is president.

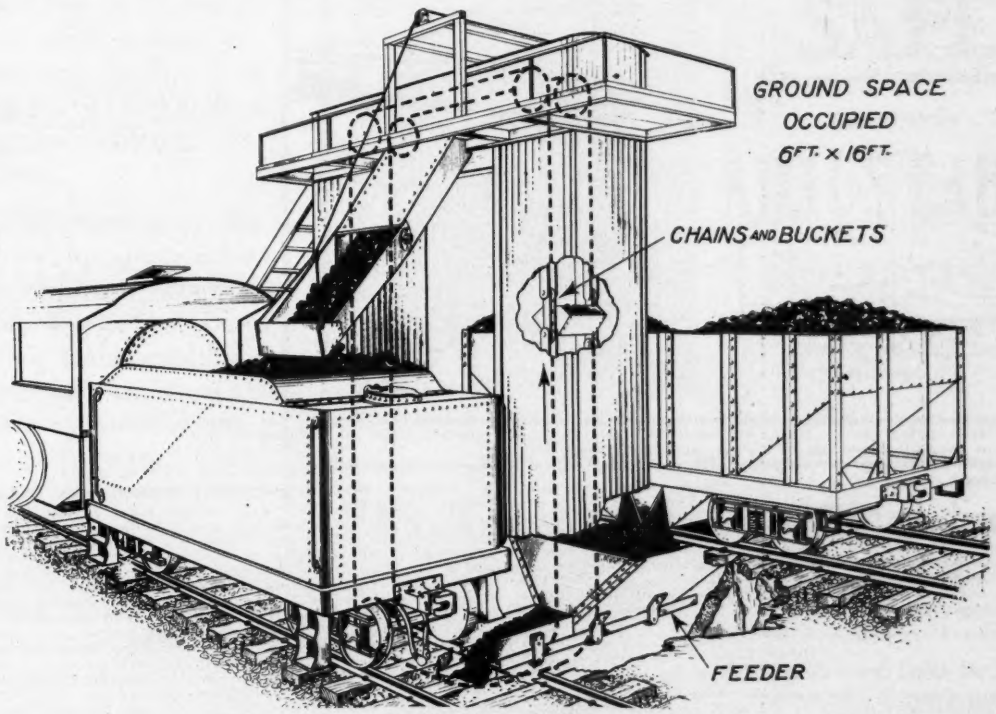
The Missouri, Kansas & Texas of Texas has purchased the Simpson building, Dallas, Texas, now being completed, which will be used for the general offices of its lines in Texas.

HETZEL COALING STATION.

By F. V. Hetzel.

To meet the demand for a compact locomotive coaling station of low cost, the Link-Belt Company of Philadelphia and Chicago has designed the apparatus shown herewith. The structure is of steel, 6 ft. by 16 ft. in plan, and stands between a car siding and the locomotive track. Under the coal siding is a steel track-hopper, into which the coal is dropped, a reciprocating feeder delivering the coal at a uniform rate to a line of chain and buckets. These buckets lift the coal to a height sufficient to chute to the locomotive tender at the rate of one ton per minute. The machinery is driven by motor or gasoline engine which is placed in a house between the two legs of the steel structure. A platform runs all around the top of the structure and a stairway leads to it from the ground.

This coaling station is not suitable for places where large quantities of coal must be carried in storage bins, but there are many railroad yards where space is valuable and where drop-bottom cars can be held in reserve with the necessary tonnage and thus act as storage hoppers. Considered as a fire-proof bin, a drop-bottom car at $900.00 is a comparatively cheap means of providing 50 tons coal storage.



Hetzel Coaling Station.

A station of this kind can be built for less than $4,000.00 complete. It is compact, fireproof, and one man can attend to the machinery as well as unloading the drop-bottom car. The control levers are arranged so that the machinery can be stopped and started readily from several points.

It is reported that the Paris & Mt. Pleasant will construct a 5,000-ft. trestle and a 150-ft. steel span bridge at Sulphur Springs, Texas.

The Wisconsin R. R. Commission, Madison, Wis., has instructed the Wisconsin & Northern to build, in connection with the extension from the Western Siding to Antigo and from Shawano to Menasha, an overhead crossing at Appleton, Wis., where the line crosses the Chicago and Northwestern.

Industrial Notes

The H. W. Pickett Co., Philadelphia, has purchased and has for prompt shipment one of the Marion Steam Shovel Co.'s new Model 61 steam shovels, and has also purchased a second-hand Model 60 Marion steam shovel.

The Oxweld Railroad Sales Co. has been incorporated in Chicago with a capital of $100,000 to deal in railroad supplies and other commodities; the incorporators are Charles B. Moore, Merritt C. Beymer, John K. Murphy.

The Browning Engineering Co. has been incorporated in Chicago, with a capital of $2,500; manufacturing and dealing in locomotive cranes, steam shovels, etc.; the incorporators are Paul N. Dale, Ira Ryner, Irma N. Burdette.

Templeton, Kenly & Co., Ltd., Chicago, have moved their Chicago offices and shops from 1335 Sloan street to their new plant at 1016-1024 South Central avenue.

The Westinghouse Electric & Manufacturing Co., reports the receipt of an order from the Pacific Gas & Electric Co., at San Francisco, Calif., of one 1,000-kw., 2-bearing, synchronous motor-generator set, consisting of one 1,000-kw., 550-700 volts, 514 r. p. m., direct current generator, and one 1,440 h. p., 2,300-4,000 volts, 3-phase, 60-cycle synchronous motor complete with switching equipment.

Horace E. Horton, president and sole promoter of the Chicago Bridge & Iron Works, died at his residence in Chicago, on July 28, after a long illness.

The George M. Newhall Engineering Co., Philadelphia, Pa., has received an order from the Pennsylvania for 10 wrecking cranes of 120 tons' capacity each. The cranes will be made by the Industrial Works, Bay City, Mich.

The Westinghouse Electric & Manufacturing Co. has just issued a series of descriptive leaflets (Nos. 2465 to 2473) illustrating the new line of switchboard seven and nine-inch indicating meters. On each leaflet is a full-size fac-simile of the meter dial, the purpose being to present a correct idea of the actual appearance of the meter when installed. By placing these leaflets on the wall an accurate idea of the readability of the

Recent Engineering and Maintenance of Way Patents

TRACK WRENCH.

1,033,182—C. H. Luthman, Assignor to the National Surface Guard Co., Chicago.

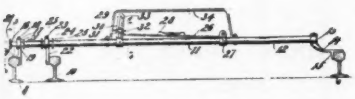
The combination of a rigid frame comprising spaced and connected side frame members shaped at their forward ends to form yokes adapted to extend over a rail, a transverse frame member which connects the rear ends of the side frame members, and means at the forward ends of the yokes for engaging the frame with the head of a bolt; a socket head, a rearwardly extending shank on the socket head fitted to a bearing in the rear transverse frame member so as to be movable therein both endwise and axially, a handle provided with a bearing rotatively fitted to a bearing on the socket head, a ratchet wheel secured to rotate with the socket head, a reversible pawl on the handle adapted to engage the teeth of the ratchet wheel and arms rotatably mounted on the shank of the socket head which engage beneath the side frame members.

STEEL CROSS TIE.

1,033,381—J. R. Campbell, Monona, Ia.

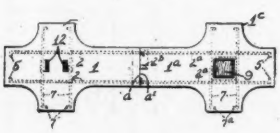
This combined railway rail fastener and tie comprises clamp plates bearing upon the opposite sides of the vertical webs of two rails, the clamp plates each having a lateral flange depending below the flanges of the rails and with an intermediate recess in one of the depending portions forming bearing shoulders. A tie extends beneath the rail ends and is engaged by the bearing shoulders, a stationary brace lug is carried by the tie and bears upon the lateral flange of one of the clamp plates, a movable brace lug

1,032,509

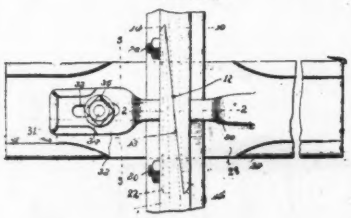


1,033,400

1,032,567



1,033,381.



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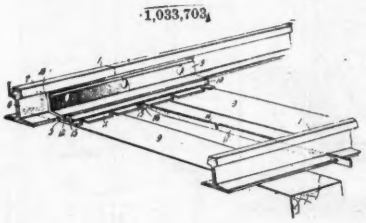


1,032,577.

supported upon the tie and has a bearing over the lateral flange of the recessed clamp plate. Means are provided for adjustably clamping the movable brace lug to the tie, and clamp devices operate through the clamp plates and the vertical webs of the rails engaged thereby.

SWITCH POINT.

1,033,400—Paul Hoffman, Assignor to the Ajax Forge Co., Chicago.

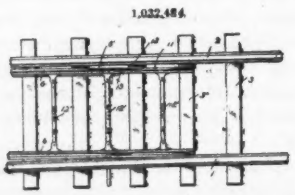
A switch point consisting of a switch rail, and a wear member, the wear member being provided with symmetrically disposed projections adapted to engage the switch rail in a plurality of positions, whereby a new wearing surface may be adjusted and secured in operative position when one of the wearing surfaces becomes worn.

CROSS TIE.

1,033,614—J. O. Otterbein, Altoona, Pa.

A rail tie designed channel-shape in cross section, the base of which is provided with a pair of enlarged openings arranged adjacent the respective ends, the base being also provided with a

1,032,484



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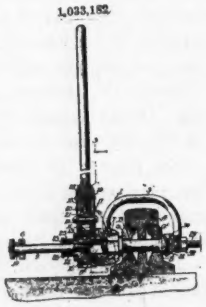
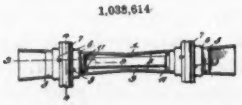


1,033,614



struck up portion extending longitudinally of the tie between the openings, wedge blocks mounted in the tie immediately over the openings therein, the side walls of the tie being provided with cut-away portions at the points wherein the blocks are disposed, bracing strips secured to the side walls of the tie on opposite sides of the cut-away portions thereof, and means to secure rails to the blocks between the bracing strips.

RAIL JOINT.

1,033,703—G. W. Jones, Canandaigua, N. Y.

A rail connection comprising a chair having an angular and a vertical upset portion, the chair being further provided with a projecting longitudinally extending curved way, the chair being further provided with a key hole slot, an angular fish plate, the fish plate having its vertical wall formed of resilient material, means for connecting rail members between the fish plate and the upset portion of the chair, a spacing bar having one of its ends provided with a key bit which is adapted to engage within the key hole slot of the chair, and the opposite portion of the bar having a slot to correspond with the cross sectional form of the rail opposite the chair and adapted to engage with the base flange of the rail.

SWITCH POINT GUARD.

1,032,484—D. S. Jones, Norfolk, Va.

In combination with a switch point, a guard therefor consisting of an auxiliary point, the guard being tapered toward both its ends, and being wider at its central portion than the switch point. Means are provided for rigidly connecting the guard with the switch point in advance thereof.

ADJUSTABLE TRACK GAGE.

1,032,509.—E. B. Schneider and Frank Herrick, Mountain, Wis.

An adjustable track gage comprising: a gage beam having a squared portion at one and and provided at the other end with a rail engaging fork, the prongs of which are offset from the beam and have rail engaging projections depending downwardly therefrom; a gage arm adjustably mounted on the squared portion of the beam and depending downwardly therefrom and provided with an outwardly extending rail engaging projection; a guard rail gage arm adjustably connected to the beam and positioned between the foot and the gage arms; a slotted segmental guide carried by the beam and having two portions upstanding therefrom; a lever arm pivotally connected to the beam and provided with a level adapted to adjust the angle of the beam with relation to the level, the free end of the lever arm positioned between the two portions of the segmental guide; and a screw extending through the slots of the segmental guide and engaging the free end of the lever arm and provided with a nut to clamp the lever arm in positions of adjustment between the two portions of the guide.

CROSS TIE.

1,032,567. C. D. Smith, Birmingham, Ala.

A railroad tie comprising a pair of duplicate concrete sections with longitudinal rods anchored in each section, the rods projecting from the ends of the sections and provided respectively with hooks and eyes adapted for detachable connection when holding the sections abutting against each other, said sections having undercut portions adjacent the projecting ends of the rods permitting a downward flexing motion of the outer ends of the sections.

FROG.

1,032,577. C. A. Alden, Steelton, Pa.

In a railroad frog, a wing rail having a head, a steel casting forming a base plate, a point portion and a wing rail engaging portion, and means for securing the wing rail and the casting together, the wing rail engaging portion comprising a longitudinally-extending web rising from the base plate and having a head formed on the top thereof and extending laterally therefrom and forming a lateral continuation of the head of the wing rail.

New Dixon Railroad Booklet

We have just prepared a booklet treating of the various Dixon graphite products for use on the railroad. The entire Dixon railroad line is treated of and all other matters excluded—this booklet is of interest only to the various mechanical railroad departments.

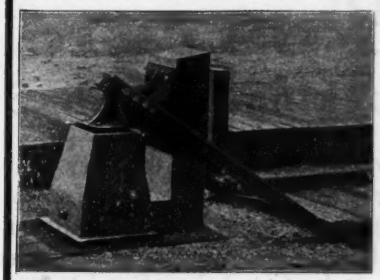
The application of dry graphite for lubrication, the use of Dixon's graphite greases, Dixon's Silica-Graphite Paint, crucibles, facings, crayons, etc., is all included in this booklet—a total of 40 pages. There is bound to be some matter to interest you here.

We have tried to make our booklet attractive in appearance as well as interesting to read, and to this end have included views taken of railroad stations and yards, stretches of track, signals, bridges, etc.

Write for copy of this booklet by number 187 R. R.

Joseph Dixon Crucible Co.

Jersey City, N. J.



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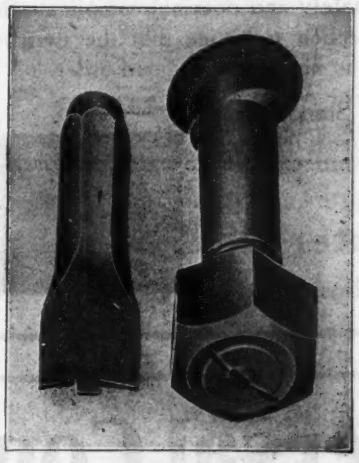

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Interlocking Switch Stand

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Any track device which is not operated by experienced men must be simple and positive. One throw of one lever parallel with the track performs all operations with the Foster Interlocking Switch Stand. This stand guarantees safe switches between times of inspections and is easy and simple to operate. It provides additional safety and does not complicate the operation of your switches. Your inspection is to see that the switches are in good order and this stand is made to keep them in good order.

One throw of ONE LEVER operates Switch, Interlock, Signals.

Foster Interlocking Switch Stands have been tested in service and do all that is claimed for them.

Frank M. Foster

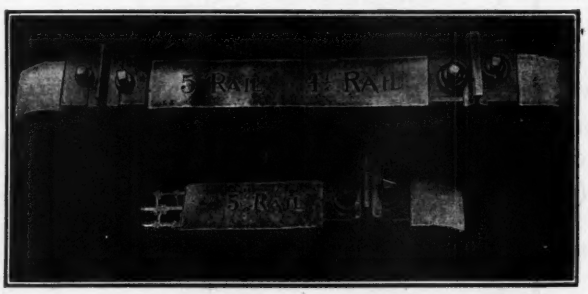
515 W. First Ave., Columbus, Ohio

The Universal Concrete Tie

Note carefully the details of the spiking device and the peculiar "V" shape of the base of the Tie at the center, which insures an absolutely perfect alignment, obviates spreading of the rails, or the slewing of the track. The heavy hardwood cushions preserve the rolling stock as well as the tie; last for six to fifteen years, and are then almost instantly removed by the loosening of the screw spikes by one man.

The Percival Patents

In use under various Trunk Line Railways for five and six years past.



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UNIVERSAL CONCRETE TIE COMPANY

1408-9 Whitney-Central Bldg. NEW ORLEANS, LA.

The above cut illustrates the Universal Concrete Tie.

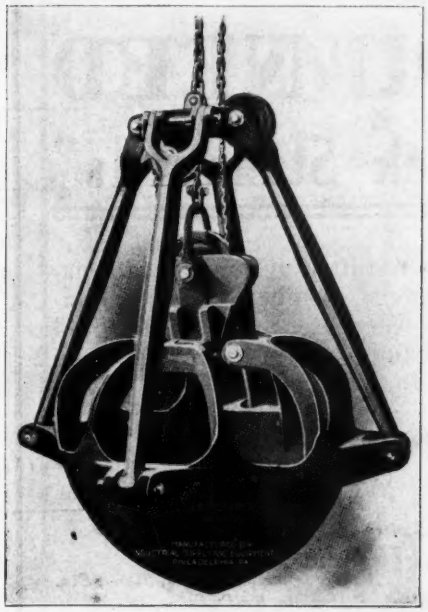
Trains are running sixty miles an hour over these ties, and have been so running for more than five years, yet they have had no repairs, realigning or even tightening of the spiking devices.

The reinforcement of our ties consists of four corrugated bars, the approximate length of the tie, and varying in size from 1-2 in. to 1 in. These are secured in proper shape by electro-welding the heavy binding wires. The truss core of the tie thus forming a complete unit within itself.

The best tie for terminals, because it is permanent.

The best tie for yards, because it is fire proof, rust proof, and will hold rails true to gauge.

The best tie for main lines and heavy traffic, because it is absolutely dependable under all conditions, as we can show in roads using them.



Rickards Cast Steel Orange Peel Buckets

The Bucket for Hard Service

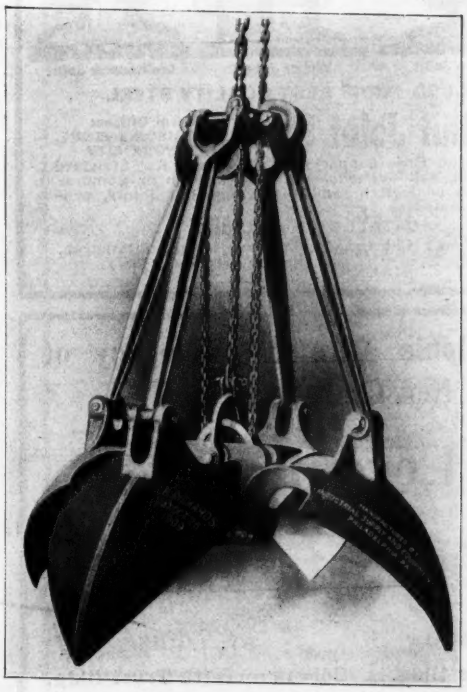
Rickards Orange Peel Buckets are constructed with four curved triangular cast steel blades, and when closed form a tight semi-spherical bowl, which holds the excavated material.

Rickards Bucket parts are interchangeable and are numbered and lettered. Reference to the number of the bucket being all that is necessary in ordering any part.

The Center Block is made of cast steel and fitted to carry and allow the bucket to hang central at all times.

All buckets are fitted with chain wheels, as this construction has been found more desirable. Buckets to be operated by wire rope will be furnished if so ordered.

The Rickards Orange Peel has been so designed that three sizes of blades can be used on the same crown rigging. That is, you can buy say a 1 yard Bucket and also buy ¾ yard and 1¼ yard blades for same rigging.



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An insulated socket wrench to fit R. S. A. binding post nuts.

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THE RAILWAY LIST CO.
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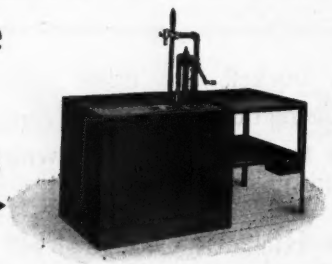
Bowser Table Tank for Way Stations



It just fits the conditions at way stations or oil houses for cleaning and filling signal lamps.

The pump measures the oil into the lamp and the table catches any dirt or spilled oil. The table serves also as an ideal place for trimming and cleaning the lamps.

This is but one unit of the

Bowser Storage Systems

which covers the entire oil storage field. Get our illustrated book No. 40. Free.

S.F. Bowser & Co., Inc.,
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The Rail Joint Co. General Offices: 185 MADISON AVENUE, NEW YORK CITY

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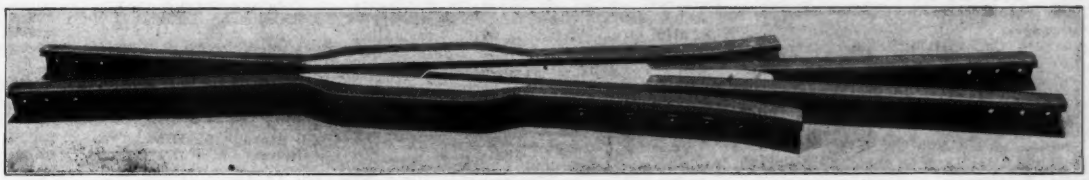
is what you want. That is what you get when you order your manganese frogs from the ***Frog, Switch and Manufacturing Co.***

Our products are the result of 30 years' experience in the field.



Manganese Hard Center Frog—Patented

Wing rail pieces, throat, point and heel blocks are one manganese casting. The entire wearing surface of this frog is so completely protected with manganese steel that it is especially adapted for use under the most severe traffic. The manganese insert extends beyond the ends of the wing rails in the throat of the frog.

We have one of the largest and most modern plants in the country, and are prepared to give your orders ***prompt attention.***

Solid Manganese Frogs and Crossings—Manganese Switch Points

Established 1881

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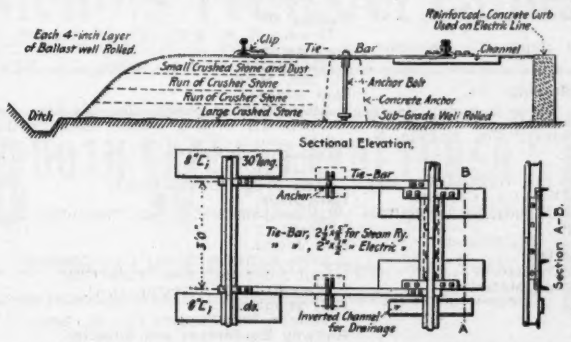
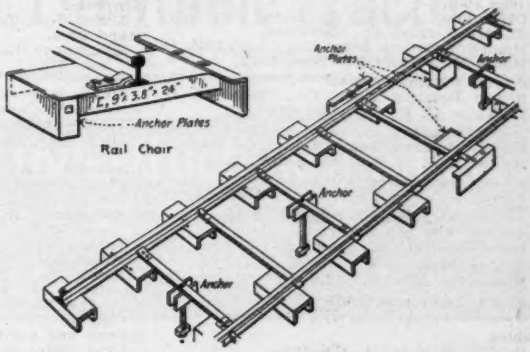


Track Construction with a watertight bed of rolled stone ballast.



Track Construction for very heavy traffic, used in connection with heavily rolled bed of broken stone.

A reinforced compacted monolithic bed or permanent way is a support for the rails and rail chairs. The chairs may be considered under the head of tie plates. My bed represents both the ballast and wooden ties combined. A bed constructed on my plan will answer every condition required of both, and more too. The alignment is permanently maintained, as well as surface and gage. It will admit of the use of anti-creeper appliances. There is a scrapping value in the steel after being used. The bed will not settle out of sight in the soft ground and be lost. It is practically water-tight, and has a tendency to prevent the settlement of embankments. It can be constructed to carry wheel loads of 30,000 lbs. each at maximum speeds.

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Interlocking Nut & Bolt Co., Pittsburg.

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Gray, Peter & Sons, Boston, Mass.

Oil Storage Systems.
Bowser, S. F., & Co., Ft. Wayne, Ind.

Oil Tanks.
Bowser, S. F., & Co., Ft. Wayne, Ind.
Wm. Graver Tank Wks., E. Chicago, Ind.

Paint Sprayer.
F. J. Lederer Co., Buffalo, N. Y.

Paints.
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Glidden Varnish Co., Cleveland, O.
Mamolith Carbon Paint Co., Cincinnati, O.
Moore Mica Paint Co., New York.
Pendleton & Co., Stapleton (S. I.), N. Y.

Pencils.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Perforated Metal.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Picks.
Hubbard & Co., Pittsburg, Pa.

Pipe Line Carrier Bases.
Universal Railway Supply Co., Chicago.

Pipe, Wooden Water.
Michigan Pipe Co., Bay City, Mich.

Plate. (See Tie Plates.)

Pole Line Material.
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Hubbard & Co., Pittsburg, Pa.

Poles, Steel.
Electric Ry. Equip. Co., Cincinnati.

Post Hole Diggers.
Hubbard & Co., Pittsburg, Pa.

Push Cars.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Publications.
Clarke, Myron C., Pub. Co., Chicago.

Pumps, Oil.
Bowser, S. F., & Co., Ft. Wayne, Ind.

Rail Benders.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Rail Braces.
Atlas Railway Supply Co., Chicago.
Cincinnati Frog & Switch Co., Cincinnati, O.
Indianapolis Switch & Frog Co., Springfield, O.
Weir Frog Co., Cincinnati.

Rail Drills.
Indianapolis Switch & Frog Co., Springfield, O.

Rail Joints.
Atlas Railway Supply Co., Chicago.
Rail Joint Co., New York City.
Weir Frog Co., Cincinnati, O.

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Vaughn Rail Support Co., St. Louis.

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Atlas Railway Supply Co., Chicago.
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Mudge, Burton W., & Co., Chicago.
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Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati.

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Johnson Wrecking Frog Co., Cleveland, O.

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Wm. Graver Tank Works, E. Chicago, Ind.

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American Farm Gate Co., Kansas City, Mo.

Roofing Materials, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Roundhouse Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Screw Spikes.
Hart Steel Co., Elyria, O.

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Section Cars, Gasoline.
Chicago Pneumatic Tool Co., Chicago.
Concrete Form & Engine Co., Detroit, Mich.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Mudge, Burton W. & Co., Chicago, Ill.

Sheathing, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Sheet Metal.
Gray, Peter, & Sons, Boston.

Shingles, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Shovel Handles.
Wyoming Shovel Wks., Wyoming, Pa.

Shovels, Spades and Scoops.
Hubbard & Co., Pittsburg, Pa.
Wyoming Shovel Wks., Wyoming, Pa.

Signal Lamps.
Gray, Peter, & Sons, Boston.

Signals and Signal Supplies.
Nachod Signal Co., Philadelphia, Pa.
Weir Frog. Co., Cincinnati.

Smoke Jacks, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Spikes.
Dilworth Porter & Co., Pittsburg.
Hart Steel Co., Elyria, O.

Steam and Hot Water Pipe Insulation.
Michigan Pipe Co., Bay City, Mich.

Steel Forms.
Concrete Form & Engine Co., Detroit, Mich.
Marsh Co., Chicago.

Steel Plate Work.
Wm. Graver Tank Works, E. Chicago, Ind.

Stone Crushers.
Marsh Co., Chicago.

Storage Batteries.
U. S. Light & Heating Co., New York.

Striking Hammers.
Hubbard & Co., Pittsburg, Pa.

Surveying Instruments.
Seelig, R., & Son, Chicago.

Switch Lanterns.
Gray, Peter, & Sons, Boston.

Switch Rods.
Weir Frog Co., Cincinnati, O.
Ramapo Iron Works, Hillburn, N. Y.

Switches and Switch Stands.
American Valve & Meter Co., Cincinnati, O.
Atlas Railway Supply Co., Chicago.
Cincinnati Frog & Switch Co., Cincinnati.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati.

Switchboard Adjusters.
Weir Frog Co., Cincinnati.

Tank Cars.
Wm. Graver Tank Works, E. Chicago, Ind.

Tanks and Tank Fixtures.
Bowser, S. F., & Co., Ft. Wayne, Ind.
Wm. Graver Tank Works, E. Chicago, Ind.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Telegraph and Telephone Supplies.
Central Electric Co., Chicago.
Hubbard & Co., Pittsburg.

Tie Plates.
Atlas Railway Supply Co., Chicago.
Dilworth Porter & Co., Pittsburg.
Hart Steel Co., Elyria, O.

Timber Preserving Plant Machinery.
Wm. Graver Tank Works, E. Chicago, Ind.

Track Drills.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Track Jacks.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Track Layers.
Hurley Track Laying Machine Co., Chicago.

Track Laying Cars.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Track Materials.
Atlas Railway Supply Co., Chicago.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati.

Track Tools.
Hubbard & Co., Pittsburg, Pa.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Wyoming Shovel Works, Wyoming, Pa.

Transfer Tables.
Nichols, Geo. P., & Bro., Chicago.

Trolley Brackets.
Electric Ry. & Equip. Co., Cincinnati, O.

Turntable Tractors.
Nichols, Geo. P., & Bro., Chicago.

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Nichols, Geo. P., & Bro., Chicago.
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Glidden Varnish Co., Cleveland, O.

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Water Chemists.
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Water Columns.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

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Gray, Peter, & Sons, Boston.

Water Filters.
Pittsburgh Filter Mfg. Co., Pittsburg, Pa.

Water Purifiers.
Lord, Geo. W., & Co., Philadelphia, Pa.

Water Purifying Chemists.
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Booth, L. M., Co., Chicago.
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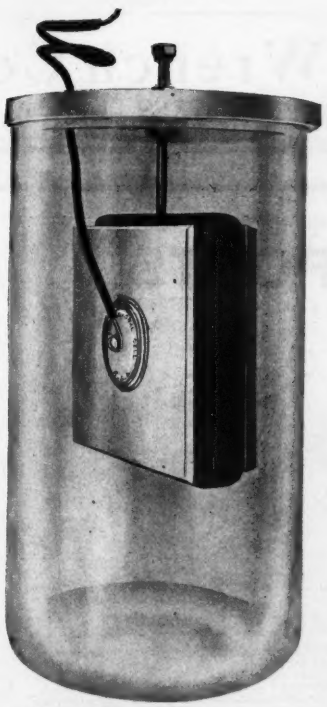

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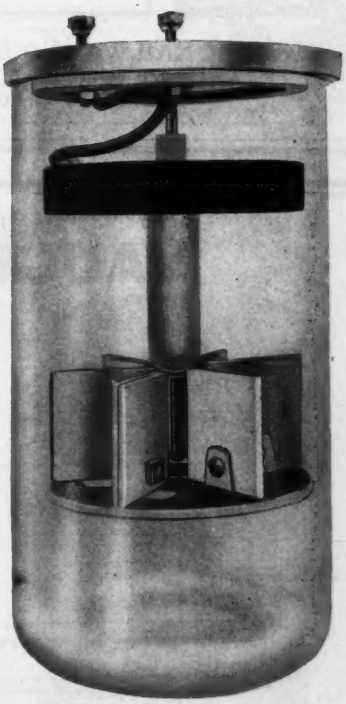

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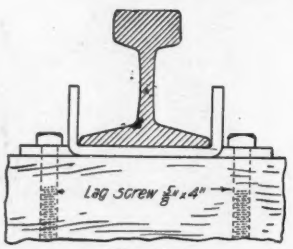

Side View
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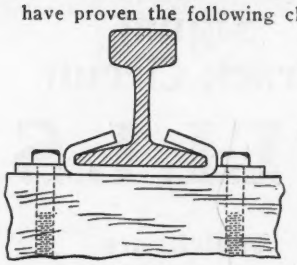
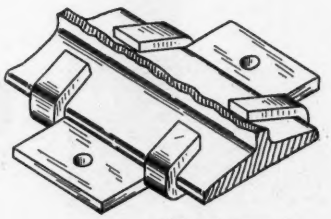
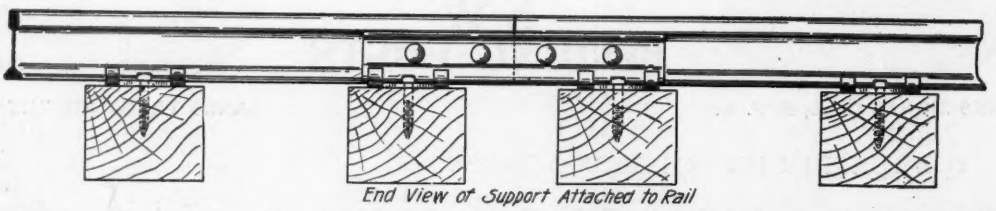


Side View
Support Applied



View of Support Attached to Rail.



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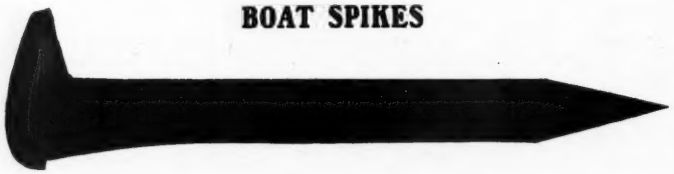

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